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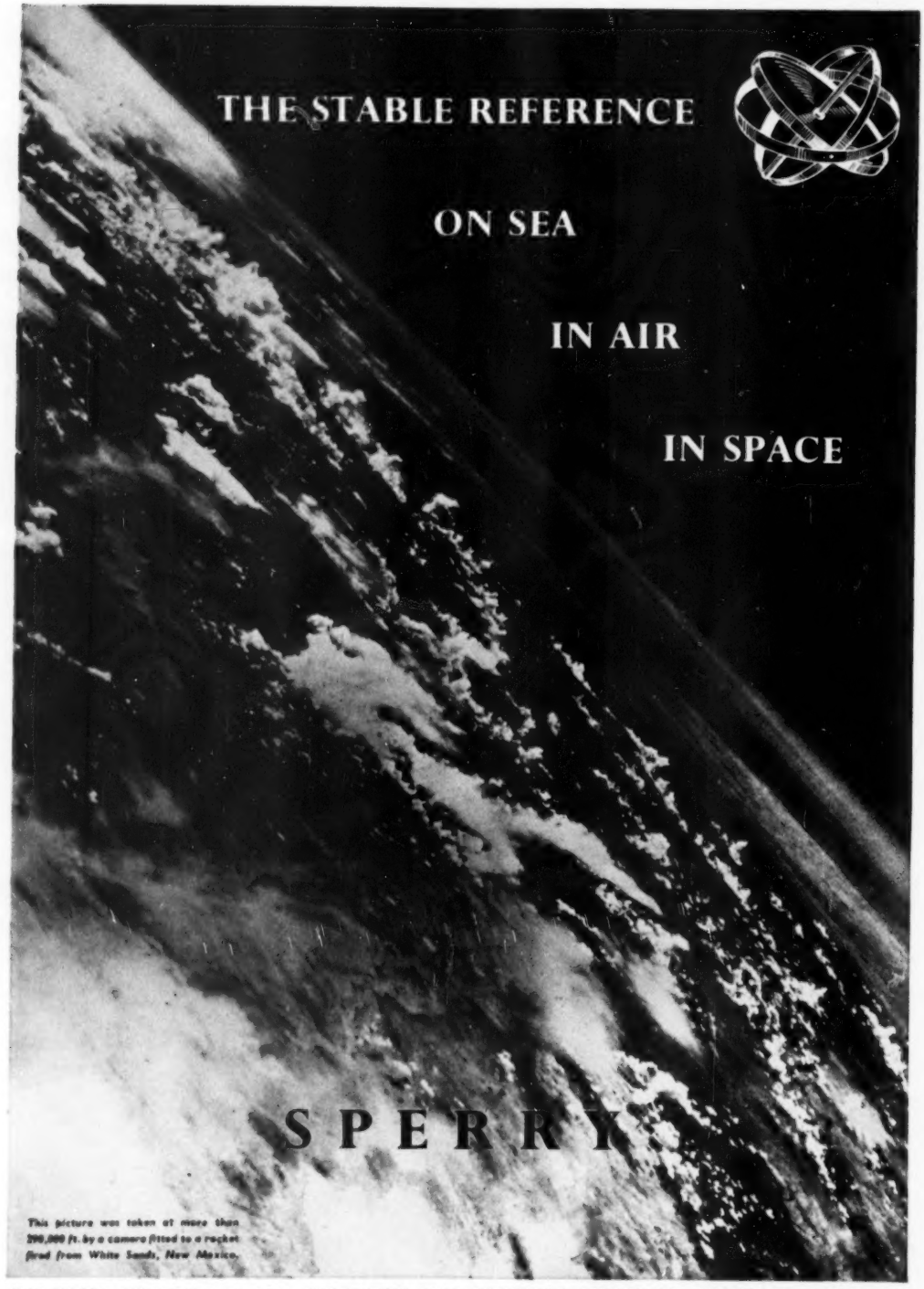

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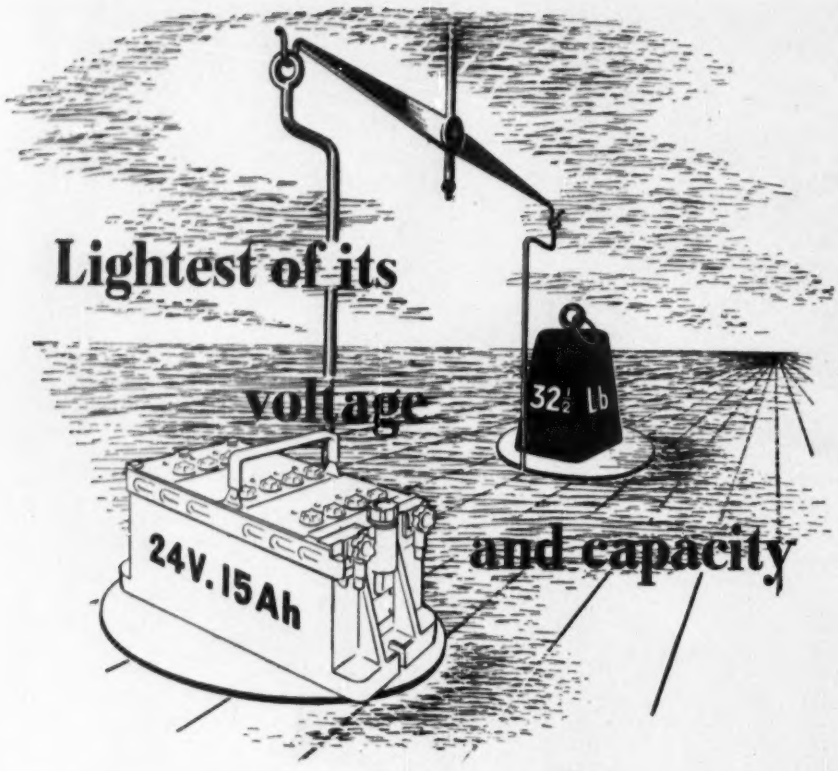

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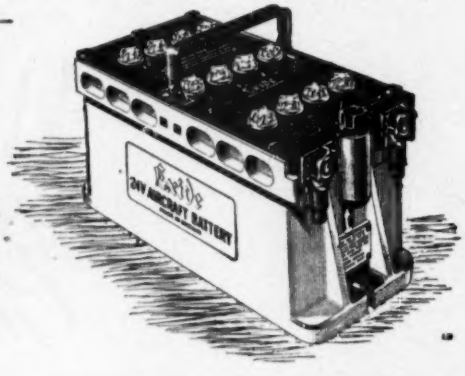

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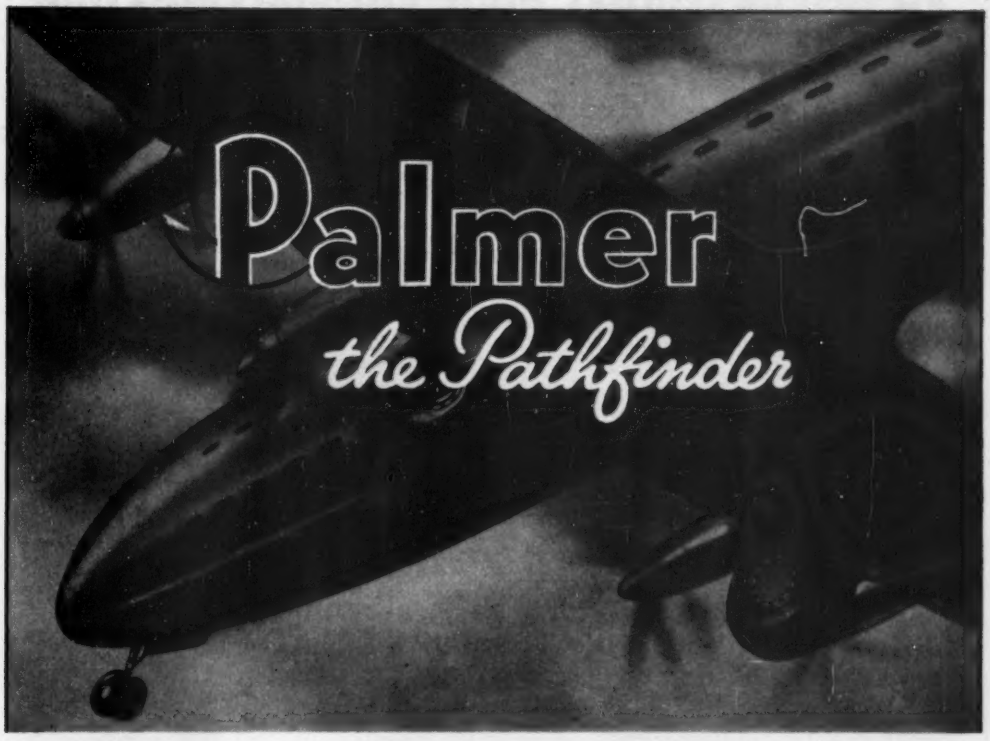

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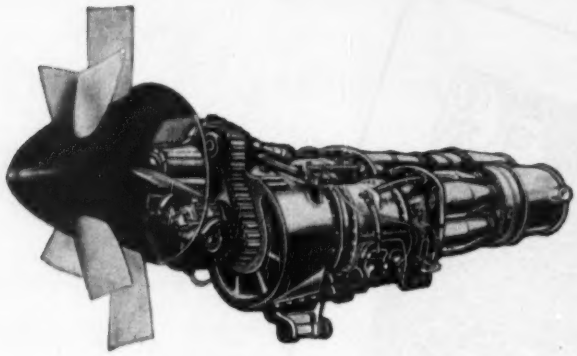

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First Aeronautical Weekly in the World

Founded 1909

No. 2242 Vol. LXI. FRIDAY, 11 JANUARY 1952

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STAMFORD STREET,
LONDON, S.E.1.

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Tomorrow's Traffic

THE first week of the new year has seen a most important event in the maiden flight of the Bristol 173. First British twin-engined helicopter to fly, the 173 represents a new advance towards B.E.A.'s requirements as outlined by Lord Douglas and later specified in detail by Mr. Peter Masefield. In particular, the 173 does provide twin-engined safety and thus, later on, will permit trial operations into city centres.

To the ordinary traveller the potential convenience of the helicopter—a quality which he can visualize clearly—is probably its greatest attraction, for as yet he has no real experience of the safety it can offer by virtue of a hovering approach, nor are its economics of any real concern to him. Very few air travellers on the short routes to European countries give more than a passing thought to the type of aircraft which carries them. In a year or two's time the fact that rotating rather than fixed wings bear it may seem to be of equally small consequence; what does matter is how much time must be wasted at and between city and airfield reception halls. With London road traffic becoming increasingly chaotic, Northolt and London Airports are, in effect, daily getting farther away from London; moreover for the majority of services they are also in the wrong direction. This fact adds to the helicopter's opportunities.

Creditable though B.E.A.'s pioneer services with Sikorsky S.51s have been, they have as yet done little more in public eyes than blaze a trail. If all goes well, the Helicopter Division will receive a Bristol 173 during next year, and some experimental operations will follow. The difference will be marked, for a three-seat machine is only in the air-taxi class, whereas a 12-14 passenger twin-engined type is a commercial vehicle half-way towards the Beabus concept. It has been estimated that a helicopter to this specification, with perhaps 40 seats, may be ready for trial operation by 1960. Between times the Bristol 173 will be the key aircraft—probably in expanded form from 1957 onwards.

We have no doubt that in ten years' time helicopter operations will be absorbing a great deal of B.E.A.'s energies and eventually to the passenger services there may be added Beatechnicons for internal and continental freighting. Silver City Airways already have ideas in this connection. Whether or not the Corporation will one day concern itself with air bus routes which are purely local remains to be seen, but traffic and housing difficulties already existing in Greater London surely foreshadow a need for South Coast to London Rotorbuses and even a Wimbledon Common—City—Hampstead Heath shuttle. Today's high prices and wages have made time expensive; perhaps, sooner than we think, the helicopter will be providing an answer to big-city commuting.

Anti-Submarine Equipment

WE have often stressed the need for new carrier-borne anti-submarine aircraft. It is obvious that the Fairey Gannet, the Navy's chosen instrument, is still far off: in the opinion of *Aviation Week*, this type—some aspects of which are discussed on page 44—is eighteen months away from production. There are, however, various mitigating circumstances, not least the fact that the Gannet is superior to any known prototype existing, or projected, abroad. Moreover, a useful A-S. conversion of the Firefly is in production, though the most ingenious adaptation could hardly be expected to carry the bulky weapons now found in the anti-submarine armoury.

More amenable to the stowage of massive search and strike loads (though itself designed for attack on surface, rather than under-water, targets) is the Douglas Skyraider, now being acquired "in substantial numbers" for the Royal Navy. Skyraiders will fill an urgent need (as will the Lockheed Neptunes in the R.A.F.) and provide yet another instance of our indebtedness to America. But, as we have pointed out in the past, Anglo-American technical traffic is by no means one-way, and a Curtiss-Wright licence for the Armstrong Siddeley Double Mamba, round which the Gannet was literally designed, and from which many of its qualities stem, gives cause for satisfaction on both sides. The view that the Double Mamba has "a very bright future" in America has been expressed by Curtiss-Wright's president, Mr. Roy Hurley, and it will be interesting to see if one of its applications is a carrier-borne machine in the Gannet class.

AIR YEAR REVIEWED

The Notable Events of 1951. Part I: January to June

January off the coast of Korea: Furies and Fireflies on the flight-deck of H.M.S. "Theseus."

WHAT a lot can, and does, happen in the aeronautical world in twelve months! Civil aviation, the Services, the industry, the learned societies—all contribute their quota to a torrent of news that is impressive enough in relation to this country alone; and when we come to survey world aviation, as it is the duty of this journal to do, the volume of rumour, speculation and fact assumes positively frightening proportions. Even in sifted, digested and annotated form as it eventually appears in our pages, the week-by-week record of events remains little short of staggering.

These thoughts are prompted by a perusal of the pages of *Flight* for the year just passed. To recall and review (as we do in this article) the story of 1951 is in itself a formidable task; much must perforce be omitted, and the main emphasis placed on British developments. What, then, were the outstanding happenings?

January.—On January 9th, in the hands of John Cunningham, the first production Comet for B.O.A.C., G-AYLP, made its maiden flight. From France, at about this time, came news that Hispano were to build the Rolls-Royce Tay under licence, and from America it was reported that construction of the U.S.A.F.'s first turboprop transport had begun—the Douglas YC-124B (four P. and W. YT-34-P1 engines). A more direct transatlantic influence was felt here on January 17th, when an imposing fleet arrived at Lakenheath, Suffolk—six B-36 bombers and three C-124 transports. A week later four U.S.A.F. Tornado reconnaissance aircraft (with tankage for 7,000 gallons of fuel apiece) landed at Manston after flying the Atlantic "by a Northern route."

On the 19th the Australian Prime Minister, Mr. R. G. Menzies, visited Biggin Hill in order formally to bestow the honoured name of Canberra upon a Tactical B.2 version of the famous English Electric bomber; after the ceremony, W/C. Roland Beamont gave one of his incomparable flying demonstrations.

On the 24th B.E.A. put their first Pionair (DC-3 converted by Scottish Aviation, Ltd.,) into service; chartered by Smiths Aircraft Instruments, it took a party of guests to Dublin, where it was demonstrated to Aer Lingus. A less happy occasion for B.E.A. was the temporary grounding of 19 of their 41 Vikings by reason of airscrew-hub trouble

Among the January activities of the learned societies was a helicopter symposium held by the R.Ae.S. Noteworthy articles which appeared in *Flight* during that month included a series by John Yoxall, describing a journey which he made in Transport Command aircraft to the Far East, where he flew on operational sorties against the bandits in the Malayan jungles; a series on helicopter development by Capt. R. N. Liptrot; an explanation of the Decca navigation system by the Technical Editor; and the final article, in a series of seven by A. R. Weyl, on fighter armament.

In lighter vein among January's news was a nice little story of a Rapide pilot who flew into the Radlett circuit while a Hermes IV was being test-flown—to be chased seven miles, and have his registration noted, by an incensed S/L. Hazelden.

February opened with the shock—pleasant or otherwise, according to the recipients' circumstances—of the announcement of the scheme for recalling R.A.F. reservists. Civil aircraft likewise found themselves faced with the possibility of wearing uniform, for the first rumours were heard of the proposal to turn the Saunders-Roe Princesses into troop-carriers (at about this time, incidentally, a trial installation of a coupled Proteus power unit was being made in the most advanced of these three big flying-boats.

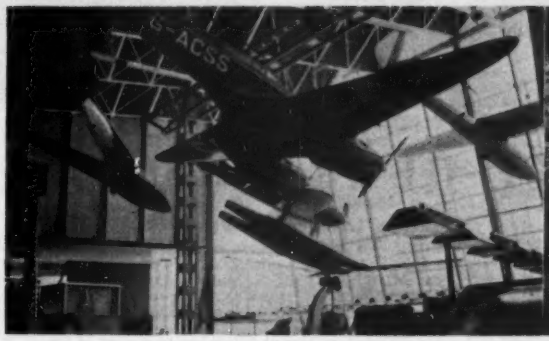
Defence preparations, in fact, had begun to show a new urgency. The first Thunderjets were on their way to Western Union countries; a "substantial" order was placed by the Admiralty, through the M.o.S., for the Fairey 17 (now known as the Gannet); the Navy conducted trials in operating helicopters from a small platform built on a merchant ship; and in America an F-84F was flown with an Armstrong Siddeley Sapphire turbojet, shortly destined to be put into production by the Wright Aeronautical Corporation as the J-65.

The necessity for a speed-up was now being almost daily underlined by news from Korea—as, for example, that the Communist Migs, "with a top speed of well over 600 kt" were threatening to prove more than a match for the U.N.'s best fighters; and some measure of this country's intentions was contained in the publication of the Air Estimates, earmarking £328½ million for the R.A.F.—a sum to be challenged as inadequate in the Commons' debate which followed shortly afterwards.

The outstanding achievement of February was undoubtedly that on the 21st, when a B.2 Canberra crossed the Atlantic from Aldergrove to Gander, in 4 hr 37 min for the 2,100 miles. The R.A.F. crew, under S/L. A. E. Callard, later flew the machine on to the Baltimore airfield of the Glenn Martin Company, who are now building the type under licence.

British civil aviation's high-spot for the month was the inauguration by the M.C.A. on the 15th, of Phase II of the U.K. Airways System. Lord Brabazon's report on relative responsibilities in bad-weather take-offs and landings was published as a White Paper. "How to Make Air Transport Pay" was the

Left: Crew of the Canberra that flew the Atlantic in February: F/L E. A. J. Haskett (navigator), S/L A. E. Callard (captain), F/L A. J. R. Robson (signaller). Right: The D. H. Comet G-ALZK, property of the Ministry of Supply, was loaned in April to B.O.A.C. for route development trials.
"Flight" photographs



"Flight" photograph

Mr. Arthur Henderson (top left) inspected Auxiliary squadrons called up, on April 16th, for three months' training. On May 18th the Vickers Valiant (top right) made its maiden flight. Lower left: 1934 *Comet, an S.6B and sailplanes at the South Bank. Lower right, the Paris Show, in June.*

subject of a monumental Brancker Memorial Lecture delivered by Mr. Peter Masefield to the Institute of Transport on the 12th. A happy occasion in sporting flying was the award of the Britannia Trophy to gliding expert Philip Wills.

With the lecture season in full spate, M. Maurice Roy, a distinguished research specialist, came from France to speak on "Power *versus* Weight"—the fourth Louis Blériot Lecture—to the R.Ae.S.

Flight published, on February 23rd, a special feature on the history of the Airspeed organization, and described the Ambassador; other descriptions in our pages included the Armstrong Siddeley Adder (February 15th) and Hiller Hornet ramjet helicopter and Northrop F-89A Scorpion (23rd). We air-tested the Auster Aiglet and Chrislea Skyjeep.

March.—There was another air test in the first March issue—of a J.5 Auster on floats—and in the same number (March 2nd) there were published the first air-to-air photographs of the Percival P.56 Provost trainer (Alvis Leonides).

Early in the month came the first guarded reports from America on the possibilities of atomic power for aircraft.

In March there were royal occasions: on the 8th Her Majesty the Queen and H.R.H. Princess Margaret visited the Bristol Aeroplane Company's works, and a week later Her Majesty dined with No. 600 (City of London) Squadron, of which she is Honorary Air Commodore.

On the 6th, the R.A.F. and U.S.A.F. co-operated in a convincing air-transport support demonstration over Berkshire. On the 20th, Air Chief Marshal Sir Hugh Saunders was appointed Deputy Supreme Commander (Air), Western Europe. Naval Aviation announced the adoption of the Westland-Sikorsky Dragonfly helicopter for air/sea rescue and communications.

In the civil aviation sphere, there was a Commons debate in which the Corporations came in for some sharp criticism, both for their business results and for their operations in relation to private charter companies; the M.C.A. Interdepartmental Helicopter Committee published its report, in which 10/12-passenger helicopters were visualized as possibly being in service by 1954; a Stratocruiser flight-simulator for B.O.A.C. was demonstrated by Redifon, Ltd.; and a daily newspaper's report that the Brabazon would presently operate on the London-Paris route was firmly denied.

In mid-month it was announced that the French S.N.E.C.M.A. organization was to build the Bristol Hercules under licence.

On the 23rd, a U.S.A.F. C-24 on its way to England with 53 men on board was lost in the Atlantic.

Major technical descriptions published in *Flight* covered the Bristol 173 helicopter (March 16th) and the development of the Armstrong Siddeley Mamba to give a 25 per cent increase in output (March 30th). In this final issue of the month, also, we were permitted to reveal hitherto secret facts about the Gloster Meteor 8, showing it to have a speed of 516 kt, climb of 30,000ft in 6.5 min and range of 955 n.m. During the previous weeks, incidentally, the first Meteor 8s (R.A.A.F.) had arrived in Korea.

April saw a new intensification of the air war in Korea, where 58 Communist Mig-15s were claimed to have been destroyed during the month by F-86s and F-84s. In Malaya, on the 26th, D.H. Vampires fired their first "shots in anger"—rockets against a bandit stronghold.

On the 16th, two R.Aux.A.F. squadrons, representing nine called up for the three-month training period, were inspected at Biggin Hill by the Secretary of State for Air.

At an Air League luncheon in London on April 19th Marshal of the Royal Air Force Sir John Slessor—about to leave for a Washington conference with other Western Union air staff chiefs—made a compelling speech on the necessity for air preparedness.

On April 2nd, Comet G-ALZK, property of the M.O.S., was handed over, on loan for operational test, to B.O.A.C.

Early in the month British aviation suffered two severe losses by the deaths, on the 3rd and 8th respectively, of Mr. W. G. A. Perring, Director of the R.A.E., and Trevor Wade, Hawker's chief test pilot; Wade lost his life while testing the P.1081, and in the House of Commons three weeks later questions were asked about ejector seats and test pilots' insurance.

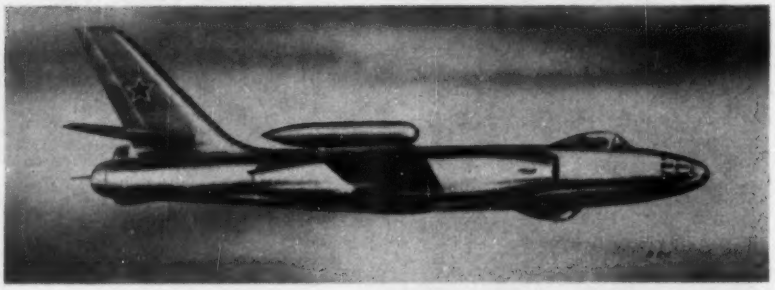
From Australia came news of the completion, on April 20th, of Capt. P. G. Taylor's 16,000-mile Pacific survey flight in a Catalina. Nearer home, on the same day, air brokers met in Paris to form the International Air Brokers' Association.

The existence of several new power units was officially disclosed, including the Napier Nomad and—subject of a licence agreement, late in 1950, with Curtiss-Wright—the Bristol Olympus. Mr. A. G. Elliott was appointed joint managing director of Rolls-Royce, Ltd., with Lord Hives. Mr. H. Povey, de Havilland's director of aircraft production, lectured to the R.Ae.S. on Comet construction methods. The lecture season closed, on the 26th, with a discussion on *Air Travel from the Passenger's Point of View*.

For *Flight* itself, an outstanding issue was that of April 20th, the special British Naval Aviation Number, containing a four-page drawing of the carrier *Indomitable*, a history of British naval flying, and other notable features. Additional noteworthy articles during the month included a contribution (April 13th) by the Hon. T. W. White, at that time Australia's Air Minister, on the 30th anniversary of the founding of the R.A.A.F.; and an illustrated description, in the same issue, of the Woomera guided-missile range. There was also an air test by the Editor (April 20th) of the Short Sturgeon.

April tail-piece: At the controls of an aircraft for the first time in six years, A. Cdre. Sir Frank Whittle made a "dead-stick" landing near Durban after his Tiger Moth's engine had died on him at the top of a loop.

(Continued on page 54)



OPPOSITE NUMBER to the English Electric Canberra, which, as mentioned opposite, will figure prominently in the next issue of "Flight", is this Russian Ilyushin bomber, powered by two Nene-type turbojets. Many are operating from German airfields and some new information concerning them is given in the paragraph "Russian News" on this page.

FROM ALL QUARTERS

More Manby Long-distance Flights

DURING this week, the first stages of a new series of long-distance training flights have been flown from the R.A.F. Flying College, Manby. A Hastings set out for the United States on Monday with a crew of 16, commanded by W/C. "Bob" Frogley, while on the following day a Lincoln left for New Zealand. Two Lincolns—one of which is the famous *Aries III*—took off on Wednesday, bound for Japan and Australia respectively, and on the same day another Hastings was due to leave for Canada and Alaska. Altogether, the six teams will cover some 105,000 miles in 550 flying hours, and will be away about a month. Not only are such long-distance flights of inestimable training and prestige value, but they provide opportunities for technical liaison abroad.

Rolls-Royce Appointments

SEVERAL changes in the company's higher-executive posts are announced by Rolls-Royce, Ltd. Mr. A. A. Rubbra, who has been with the organization since 1925, has been promoted to deputy chief engineer of the aeronautical division; Mr. F. T. Hinkley has taken over the duties of an assistant general manager and will be responsible for sales and service; and Mr. A. A. Lombard is appointed chief designer of the aeronautical division and will assume responsibility for all sections connected with design work.

Mr. A. A. Lombard

Mr. Lombard joined Rolls-Royce from the Rover Company in 1943 and was chief designer at the Barnoldswick factory until 1946. He was in charge of the design of the Derwent series of engines, the Nene, the Nene 4 (which later became the Tay) and the Clyde, which was the first compounded turboprop engine to be produced. He was also responsible for the initial design of the Derwent 5 engine which powers the Meteor Mks 4, 7 and 8. At Barnoldswick, Mr. Lombard started the design of the Avon engine, the first high-pressure axial jet, work which he continued when he came to the Derby factory as chief designer (projects) in 1946.

Russian News

THE Soviet Air Force in Germany celebrated Boxing Day with a parade of Ilyushin twin-jet bombers (see drawing on this page) over Berlin. They were observed to take off in formations of three and, although originally unpainted, except for the Red Star under the upper surfaces and squadron numbers, their upper surfaces were seen on this occasion to be finished in grey-green. This is described as "resembling the colour of the former German Army uniform." The undersides were bright sky-blue.

Mig-15s have also been active. There are now about 120 at Peenemunde and about the same number at Gaartz, while at Puettnitz, near Rostock, another 70 or 80 have been observed. Three new hangars have been erected at the last-named base, and a completely new airfield is reported to be under construction at Boltenhagen. The layout is said to resemble that of Brand-Briesen, described in *Flight* of December 21st, 1951.

Hunting Group Promotions

THREE new appointments to the boards of companies in the Hunting Group are announced. They concern Messrs. W. D. Corse, M. H. Curtis and S. Millyard, each of whom becomes managing director of, respectively, the Aircraft Operating Co. of Africa, Ltd., Hunting Air Travel, Ltd., and Field Aircraft Services Africa, Ltd.

Mr. Corse's appointment follows the retirement of Col. C. R. Robbins, M.C., D.F.C., from the post of managing director of the African company after over 25 years' service. Mr. Corse, who was a photographic specialist with the R.F.C. in World War I, joined the Aircraft Operating Co., Ltd. (now Hunting Aerosurveys) in 1921, as photographic manager, and went on most of their overseas expeditions during the next ten years. He joined the African associate in the same capacity in 1931, working in South Africa and becoming a major in the S.A.A.F during World War II. On demobilization, he was appointed to the board.

Mr. Curtis takes over from Mr. J. L. Smith, who has been executive director of Field Aircraft Services, Ltd. since January 1948. This re-arrangement will allow Mr. Smith to devote more of his time to Fields' interests at home and abroad. Mr. Curtis has had long and varied experience in air transport since he joined Imperial Airways as a trainee in 1930. Quickly promoted, he held management posts on various parts of the Empire routes. From 1944 to 1946 he was commercial manager of B.O.A.C.'s European Region, and was transferred to B.E.A. as traffic manager on their formation. He was Far East and East Africa director of Skyways, Ltd. from 1947 until he joined Hunting Air Travel as general manager in November 1950.

Mr. Millyard's appointment with Fields also follows on the retirement of Col. Robbins. Mr Millyard served in the R.N.A.S. in World War I and was subsequently an R.A.F. civilian technical instructor. He joined the Aircraft Operating Co., in 1926 and was in charge of aircraft maintenance on overseas expeditions. He took part, with Mr. Alan Butler, in the 1930 London-Cape flight by the Gloster AS.31 survey aircraft and in 1931 joined the African associate company. In the following year he became works' manager of Airservice (Pty.), Ltd.—another subsidiary of the Aircraft Operating Co.—a position which he has held ever since. Like Mr. Corse, he served as a major in the S.A.A.F., and then joined the board of Field Aircraft Services Africa, Ltd.

(Left to right) Messrs. Corse, Curtis and Millyard, whose appointments to managing directorships in the Hunting Group are referred to above.

STRATOFORTRESS is the name inscribed on the nose of the Boeing XB-52 bomber, seen for the first time in this officially approved photograph. Of the picture, incidentally, Mr. Thomas K. Finletter, Secretary of the U.S. Air Force, has said that it shows "the least possible amount of information that could be of value to an enemy," adding a request to news photographers and the American public to co-operate by refraining from taking other pictures. The XB-52 has eight Pratt and Whitney J-57 turbojets and is reported to weigh 350,000 lb. Two prototypes have been ordered. The main undercarriage (two groups of four wheels abreast) retracts inwards into the fuselage and operates in conjunction with lateral stabilizing wheels which fold up into the wing.

Second Time Up: "173" Impressions

ON page 34 of this issue we report and illustrate the first flight of the Bristol 173 helicopter. The second flight, made a day later, was witnessed by our Technical Editor. To some extent it was a slightly amplified repetition of the first, with Mr. Hosegood at the controls and Mr. Keith Turner accompanying him as flight test observer. A vertical take-off was made, the nose of the machine lifting first until, at a fuselage angle estimated roughly at 10 deg, the rear wheels of the aircraft also left the ground. Mr. Hosegood kept the 173 fairly consistently at a height of between 15 and 20ft, the aircraft hovering at its designed angle of 6 deg.

It was (writes the Technical Editor) all rather impressive. The usual scattering of people all intently watching; some were there officially, others unofficially, whilst lining the fence dividing the airfield from the road was a surprisingly large number of strictly unauthorized onlookers. Cameramen took ciné records of the flight, and a walkie-talkie provided voice contact. There was the atmosphere, intangible yet nonetheless apparent, that something really important was going on; and it was indeed, for the 173 is the first twin-engined twin-rotor helicopter in the world to have flown, and it heralds the British achievement of a rotary-wing standard owing nothing to anybody.

One of the most impressive features of the flight was the rock-like steadiness of the aircraft. It sat in the air with every appearance of ease and naturalness, and although Mr. Hosegood made no attempt at translational flight other than gradual pivotings through angles up to about 70 deg on each side of the wind direction, one at no time received the impression that the aircraft was being rigidly controlled by some cramping limiting condition. Having remained in the air for perhaps a little over a quarter of an hour, the 173 was landed, and it was then that the only untoward incident occurred. As the front wheels were on the point of touch-down—landing is a reversal of take-off in that the rear wheels leave the ground last and touch-down first—the machine started to rock laterally, evidently in ground resonance. The condition was, however, rapidly combated by Mr. Hosegood bringing the rotors to rest in remarkably short order.

I took the opportunity later in the day to have a chat with Mr. Raoul Hafner (chief designer, Bristol helicopter division) and I was pleased to see him so evidently a happy man. The chief matter of uncertainty with the aircraft had been the effectiveness of control-matching between the rotors, and on this score it was clearly apparent that the design was right. The ground resonance was not a matter about which Mr. Hafner felt much concern. It was not unexpected and, in fact, was something which could be dealt with without too much difficulty. It was, of course, a little early to be dogmatic about the aircraft, but these first two flights had at least demonstrated clearly and convincingly that the control characteristics were essentially correct, and that the level of vibration in flight was extremely low.

Loss of M.C.A. Anson

IT is with regret that *Flight* has to record an accident involving Anson G-AGZS, an aircraft belonging to the M.C.A. fleet at Stansted. In circumstances at present unknown, the machine crashed at 1815 hr near Bell Hill, Petersfield, Hants, about 50 miles from London Airport, from which point it had set out to carry out evaluation trials on the Decca Flight Log. The four occupants of the aircraft all lost their lives.

Capt. A. A. Betts, A.F.C., aged 34, who was piloting the machine, had been an M.C.A. staff pilot at Stansted since 1949. He had taken an active part in a number of Decca trials. Mr. P. V. Meyer, aged 30, had been a staff navigator with the M.C.A. Unit since 1948 and prior to his posting to Stansted had served at both Gatwick and Prestwick. The third member of the M.C.A. staff, Mr. A. S. Crisp, aged 32, was a signals officer.

The fourth occupant, Mr. J. B. Copping, born 1917, was a member of the Decca Navigator Company. Having joined the R.A.F. as an apprentice before the war he received training as a navigator in Canada and was commissioned on June 16th, 1944. His chief work was long-range meteorological flights with Coastal Command. On joining the Decca Navigator Company in December, 1945, he was associated from its inception with the air section, of which he ultimately became manager. His particular achievement was the conception of the Flight Log, in the development of which he also figured largely.

The First Canberra Squadron

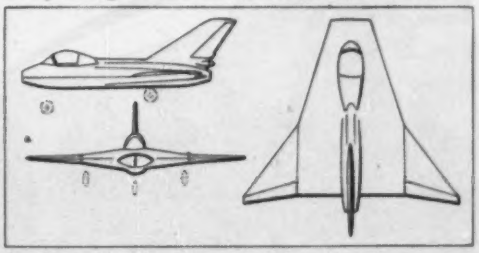
A RECORD of the development and achievements of the English Electric Canberra to date will complement an account of a visit to No. 101 Squadron, R.A.F., the first to be equipped with the type, in next week's issue of *Flight*, dated January 18th. Both features will be generously illustrated.

Gliders for Public Schools

SOME 60 schools which have R.A.F. contingents of the Combined Cadet Force are to receive primary gliders for use by the cadets. Schools at the top of the list are Tonbridge, Maidstone Grammar, Dulwich, Eastbourne College, Marlborough, Grimsby College, Fettes, High Wycombe Royal Grammar School, King Edward School (Birmingham) and Oundle. They are being issued with the Eon Eton primary glider; other schools will receive the Slingsby type.

Selected schoolmasters who have volunteered to be trained as gliding instructors have been attending one-week Christmas-holiday courses (with about 20 masters on each) at R.A.F. Station Detling. A picture appears on page 55.

Baby Dragon: the new Delta from Sweden



Illustrated in "Flight" last week, the Saab-210 Dragon is one of the smallest aircraft flying, as well as being the most futuristic. With a wing like this, such terms as "aspect ratio" and "root chord" seem to lose some of their former significance. At the time of going to press the Dragon's first flight had not yet taken place, certain vibration problems having arisen during early fast-taxying hops.

ASCENDANT TWIN: An historic first flight, that of the Bristol 173 twin-rotor helicopter is depicted here and described below. In service, it is expected to carry 10 to 14 passengers and to cruise at a little over 100 m.p.h.

HERE AND THERE

Bristol 173 Takes The Air

THE Bristol 173 made history when it took off for the first time last week, for all other British helicopter designs which have flown to date—mostly with a single rotor, but one with three—have derived their power from a single engine. The 173 is thus the first twin and the first to have two separate rotors. Offering twin-engined safety—either engine can drive both rotors in the event of the failure of the other—this aircraft is clearly better equipped to operate inter-city passenger services than any previous British helicopter.

At Filton on January 3rd, with Mr. C. T. D. Hosegood at the controls, accompanied by Mr. Keith Turner as flight test observer, the helicopter was airborne for about ten minutes. It hovered within its ground cushion and made slight forward, backward and rotary movements. The pilot reported, state the makers, that the machine responded exactly as anticipated, that vibration was slight, and that the flight was "entirely satisfactory." With a little ballast at the rear end of the fuselage, a.u.w. was about 9,000 lb.

Further hovering trials were expected to be made shortly, and the flight-test programme will continue with slow forward movements. In order that the attitude and general behaviour of the aircraft may be examined at leisure, ciné films are being taken of the first flights. More-than-interested spectators were the designer, Mr. Raoul Hafner, and the divisional managing director, Mr. C. F. Uwins.

The Bristol 173, which has two Alvis Leonides LE.23 Mk 73 engines, each with an output of 550 b.h.p., was described and illustrated in detail in *Flight* of March 16th, 1951. It will be noted from the photograph that the machine has a tailplane, with very pronounced dihedral—in effect, a butterfly tail, the purpose of which is to give stability in pitch and yaw during forward flight. Tailplane area is 50 sq ft. A maximum a.u.w. of 10,600 lb is foreseen and, as the equipped weight is approximately 7,800 lb, disposable load will be just under 3,000 lb. Rotor diameter is 48ft 6.7in, wheelbase 26ft 5in, and the step up to cabin-floor level 2ft 2in.

SATISFIED QUARTET: Left to right, Messrs. Raoul Hafner, the 173's designer; C. F. Uwins, managing director, aircraft division; C. T. D. Hosegood, pilot; and Keith Turner, flight test observer.

N.A.T.O. Tac-recce. Wing

A TACTICAL reconnaissance wing of the U.S.A.F. has been assigned to Gen. Eisenhower's NATO forces. Equipped with RB-26 Invaders and RF-80 Shooting Stars, the unit will be based in France.

R.Ae.C. General Meeting

MEMBERS of the Royal Aero Club will hold their annual general meeting on Wednesday, March 26th, at 6 p.m., when the usual business, including the election of committees, will be transacted.

Indian Trainer Lost

FROM India it is reported that the prototype Hindustan HT-2 trainer has crashed from a spin during a test-flight made at maximum weight. The aircraft, which was illustrated in *Flight* of September 28th, 1951, had completed 20 hours of flying.

Bringing it Home

THAT Russia not only has better fighters than the Mig-15, but that she also has bombers bigger than her "B-29 copies," was recently disclosed by Gen. Vandenberg, U.S.A.F. Chief of Staff. He credited the new bomber with the ability to operate deep into America from Russian bases.

Last Across

LAST of 13,000 motor vehicles to be air-ferried across the Channel in 1951, a Hillman Minx was carried to France by Silver City Airways on December 31st. Driven by Mr. G. Hinchcliffe, a Bradford garage-owner, the car is making an attempt on the 24-day overland record to the Cape.

Savage in Service

THE North American AJ-1 Savage is now in full carrier service. Looking like a baby Lockheed Neptune, the Savage is powered by two Double Wasps and a tail-mounted J-33 turbojet, and can carry an atomic bomb. U.S. Navy spokesmen said recently that "Heavy Attack Wing One" was equipped with this type to lessen U.S. dependence on overseas ground-bases.

Pillar to Post

A "HELIGOLAND" protest is reported to have been engineered against the use of Great Knechtsand, between Cuxhaven and Bremerhaven, as a bombing range by the R.A.F. and U.S.A.F. Gen. Sir Ivone Kirkpatrick, United Kingdom High Commissioner, agreed to the return of Heligoland to the Germans by the end of March, and Great Knechtsand was accepted by him and by the Federal Government as an alternative site.

Evolution — in Design

The normal, orderly process of aircraft design has evolved into the Delta planform for high altitude, long range, high speed and heavy payload. And Avro's successful 707A and B demonstrate one further important point—the Delta handles like any conventional aircraft.

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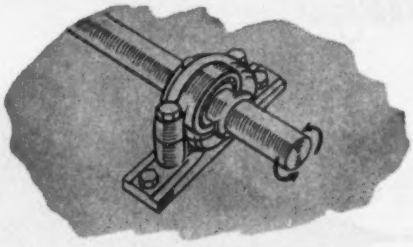
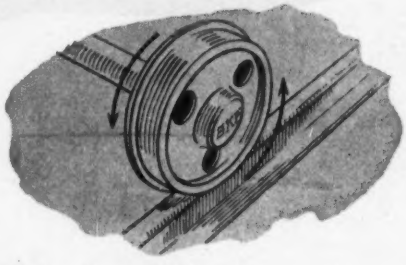
BALL & ROLLER BEARINGS

Choose the Correct Fit

If the shaft rotates, the inner ring of the bearing should have a tight fit on the shaft.



If the housing rotates and the shaft is stationary, the outer ring of the bearing should have a tight fit in the housing.



Machining the Bearing Seating

Do not use the bearing as a gauge — use a micrometer or a snap gauge when turning, and a plug gauge or other precision instrument when boring.

More precise information on this subject together with suitable machining limits for shafts and housings are given in the SKF General Catalogue.

THE SKEFKO BALL BEARING CO., LTD., LUTON

Reprints of this Advertisement are available upon request. Ask for a copy of Advertisement No. G21

HERE AND THERE . . .

Freighters for R.C.A.F.

THREE Bristol Freighters are about to be put into service by the R.C.A.F. The aircraft, two of which arrived before Christmas, will be flown by 412 Transport Squadron, at Rockcliffe, Ontario. These first two are at North West Industries, Ltd., Edmonton, where they are being modified to suit Canadian conditions. Modifications include installation of R.C.A.F.-type radio equipment, de-icing and heating gear.

Misses and Missiles

"WHERE are they gonna pin the medals?" enquires U.S. columnist Ollie Crawford, who has been reading about the new squadron of B-61 Matador guided missiles. Quoted in *The Martin Star*, Crawford goes on: "The new bomb can do anything a pilot can do, except hug a blonde. There's no use of a gal waiting at the air base, if nothing comes out but a loud ticking noise. The squadron may be popular with the top brass, but the gals will notice something missing. Their idea of an atomic warhead has blue eyes, curly hair and a deep tan. The Air Force may think this new design is wonderful, but those tall, dark and handsome combinations weren't bad. Pilotless missiles just mean pilotless misses."

The Export Picture

"THERE are special reasons why we in Britain should maintain our exports while carrying out our defence programme. The British Isles lack almost all the raw materials essential to an industrial country and at the utmost can only provide a bare half of the food needed to keep the population fit; so our economy depends on our being able to pay for vast essential food and raw material imports. We are therefore giving very special attention to the needs of export industry and I believe that, once this is realized, it materially alters the picture which the 1952 British Industries Fair might otherwise present."—Mr. Peter Thorneycroft, M.P., President of the Board of Trade, in an article on the B.I.F., which opens on May 5th.

SPEEDY HACK: The world's first five-jet aircraft is this North American B-45 Tornado jet bomber, used as a flying test-bed by General Electric. It will be seen that the turbojet under development is suspended beneath the fuselage. Standard power plants are four General Electric J-47s.

IN BRIEF

MR. H. C. EDMONDS, overseas sales development manager of Oldham and Son, Ltd., left London on January 1st for Lagos, Nigeria. He is making a 20,000-mile air tour to open up new markets for Oldham batteries in Africa and to visit the firm's agents there.

* * *

Major staff changes in the aircraft division of Avro Canada—designed to accelerate CF-100 production—involve promotion of three Englishmen and a Canadian. Mr. Edgar H. Atkin has the newly created position of technical director, while Messrs. James C. Floyd and Dennis E. Wiseman respectively become chief engineer and works manager. Mr. Fred T. Smye—a Canadian and the company's first employee—enters the newly created post of general manager.

MR. H. T. PARKER, general manager of Plessey's marketing division, is to leave the company's full-time employment, "for new fields in sales promotion," but will act as Plessey publicity adviser.

A 20-page booklet describing in detail the general properties of Skydrol, a non-inflammable synthetic hydraulic fluid, and including latest data on its evaluation in the laboratory and performance in aircraft installations, has been issued by Monsanto Chemical Co., St. Louis, Missouri, U.S.A.

* * *

Acheson Colloids, Ltd., London and Plymouth, manufacturers of the well-known "dag" products, have formed a London Chapter of the Acheson Twenty-Five Year Club. At the inaugural meeting, Mr. Howard A. Acheson (chairman and managing director) presented gold wristwatches to seven members, all of whom had completed at least 25 years' service.

* * *

C. C. Wakefield and Co., Ltd., announce the appointment of Mr. Alonzo Limb—who joined the company in 1916—as sole managing director. He previously shared this post with Mr. W. H. Senneck, who has now retired after 45 years' service but retains his seat on the board. The appointment of Messrs. W. F. List and L. M. Broadway as assistant managing directors is also announced.

* * *

Messrs. S. G. Deaves, Fraser Bryant, A. E. Hughes and P. H. Gibbs are all appointed sales managers of various divisions of the British Tyre and Rubber Co. group. Messrs. Deaves, Hughes and Gibbs are located at Herga House, Vincent Square, London, S.W.1, while Mr. Bryant will continue to operate from the depot at 6, Star Road, London, W.14.

A NEW FLY I: These famous registration letters will remind readers that Lord Brabazon of Tara is the distinguished holder of R.Ae.C. Aviator's Certificate No. 1. Although popularly associated with the aircraft industry, Lord Brabazon is also a director of the David Brown Corporation which controls, among other things, the manufacture of Aston Martin high-performance cars. He is seen here, at right, taking delivery of a D.B.2 sports saloon from Mr. David Brown. The car, of over 100 b.h.p., is in R.A.F. blue, with leather and carpets to match.

BOOSTING GAS TURBINES

Why it is Desirable and How it is Done: Water-Methanol and other Injectants

By W. T. GUNSTON

MOST of us are familiar with the use of water and other liquids as anti-detonants in piston engines. We know, also, that there is no detonation problem in the gas turbine; and some of us are puzzled by the fact that "wet" ratings are becoming as common on this new prime mover as they ever were on its reciprocating predecessors. Why this is so, and how water can make such a difference to the output of a gas turbine, is explained here.

WHY is water-injection a desirable feature of gas-turbine design? Quite apart from the obvious advantage of having an increased power output available for emergencies, it is fair to say that most turbines are cruised nearer to their maximum output than are most aircraft reciprocating engines. One evident result is that, in a turbine, there is a smaller reserve of power available when it is most needed. Some people will be inclined to disagree strongly on this point, but the fact remains that with a turbojet or turboprop there is less "in the bag"; it is being used already. Consequently, it is doubly important to provide some means of increasing the power rating for emergency use, even if it is only available for short periods.

Afterburning, or jet-pipe reheat, is one solution that is becoming popular for fighters. It is undoubtedly of value for turbojets, particularly in very fast aircraft. It carries, however, a heavy weight and space penalty, and has a further drawback in that the whole operation of a turbojet so equipped is a compromise in which the cruising condition usually suffers.

A very interesting approach to the problem is seen in the Double Mamba, which, in its application to long-range naval aircraft, may be said virtually to embody a complete spare engine for take-off, combat and emergencies.

It cannot be denied, however, that a power-boosting system capable of being (almost) clapped on to an installed power plant has a great appeal, and in this field water injection has an apparent monopoly.

How does water injection work? Considering the basic Newtonian $P=Mf$ equation behind every turbojet (and turboprop), it is clear that increased output can be obtained only by increasing either the total mass-flow or the mean gas acceleration.

Continuing with the formulæ, many readers will, at some time or another, have had drummed into them something like:

$$\text{Power required} = \frac{n}{n-1} RWT_1 \left\{ (P_2/P_1)^{\frac{n-1}{n}} - 1 \right\}$$

They may even recognize it as referring to air compressors. The important part here is the factor T_1 which shows that the power required to drive an air compressor is usually dependent directly upon the ambient intake-air temperature. This fact is the key to the whole business.

One of the simplest ways of cooling the intake air is to inject into it a spray of volatile liquid. Cooling is then achieved by reason of the fact that the latent heat of vaporization required to convert the spray into vapour is extracted from the air. From this a number of effects are likely to result.

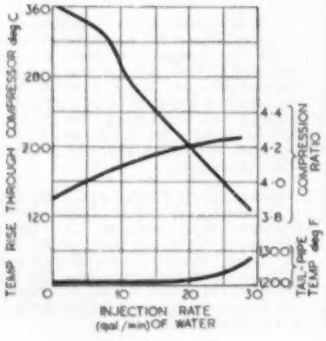


Fig. 1. Effect upon compressor performance and tail-pipe temperature of a varying injection rate: General Electric I-40 unit, with injection of pure water.

If the power taken by the compressor is to remain constant, the better pressure ratio P_2/P_1 across the compressor will result in increased mass-flow and jet velocity; thus we have increased both M and f, since in any given engine f is proportional to final velocity. For an unchanged fuel consumption, this will give a "weaker mixture" and will reduce operating temperatures throughout. Alternatively, increasing the intake-air cooling will eventually result in a decrease in compressor power requirements and a corresponding rise in jet-pipe temperature. Again, it may be necessary to burn more fuel in order to vaporize all the cooling liquid and heat the steam to combustion temperature; this extra fuel is partly wasted.

In actual practice, of course, all these factors are interdependent and with varying intake-cooling the overall result is interesting. Some experimental results from the U.S.A. are shown in Fig. 1. Cooling liquid injected into the intake-air will begin to evaporate at once, at a rate principally determined by the spray-droplet size and the air turbulence. As the spray passes through the compressor, more and more of it will evaporate, until there is no liquid left; some liquids will vaporize completely before the compression stage is over. This will result not only in "continuous intercooling," but also in a progressive increase in volume-flow and hence in both flow-velocity and acceleration. There will also be a reduced temperature-rise in the compression stage and, therefore, a better pressure ratio. If all the cooling liquid can be made to evaporate before entering the compressor, the resulting increase in pressure ratio will be a maximum, but this ideal is possibly unattainable. For any given engine condition, the proportion of the spray evaporating before the compression stage will be dependent upon the boiling point of the liquid injected; clearly, this should not be greatly above the intake-air temperature at the ram pressure prevailing.

The ideal cooling liquid will have a high specific heat and (more important) a high latent heat of evaporation and low boiling-point, as well as a high calorific value. It will be non-toxic, non-corrosive, will leave no deposit when burnt, and will be cheaply obtainable in a pure state. There is, unfortunately, no such liquid. A number, however, approximate to this ideal, but all are deficient in one or more properties. Nevertheless, these possible coolants are worth considering individually; their chief properties in this connection are shown qualitatively in Fig. 2.

Water.—The most readily available coolant, water also has by far the greatest latent heat and specific heat. Unfortunately, its boiling-point at usual ram pressures is considerably above ambient temperature, so that it is difficult to evaporate large amounts ahead of the compressor. Furthermore, as its calorific value is zero, it merely tries to put the fire out. One interesting effect, more useful on "heavy engineering" gas turbines, is a tendency towards the water-gas equation, $C+H_2O=CO+H_2$, reducing carbon formation.

Methanol.—Methyl alcohol, CH_3OH, is very attractive. Its latent heat is less than half that of water, but is still high. It also has a lower boiling-point and a high calorific value. In actual practice, when neat methanol is injected only about half actually burns, but it still gives one of the

greatest boosts for a given percentage injection. Its partial combustion does result in increased temperature at the turbine and tail-pipe, and its use must be carefully regulated. In combination with water, it forms an extremely attractive combination, in which the best of both worlds (boiling-point and latent heat) are obtained, quite apart from the anti-freeze provided by the methanol.

Ammonia.—Pure ammonia, NH_3, is a gas at the pressure and temperature found in the usual air-intake, and thus there is no boiling-point problem at all. Further, among available liquids, it has a latent heat second only to that of water and it dissociates in the combustion chamber to yield hydrogen, which partly burns to give a fair overall calorific value. At first sight it might appear ideal for the job, and certainly can give startling results, but it, too, has its drawbacks. Ammonia vapour with air can form a violently explosive mixture; it also has dangerously offensive properties, both to human beings and to copper-base alloys (it may meet these alloys in turbine bearings). Finally, its use is rather limited by atmospheric conditions in that ammonia gas, when combined with water, liberates heat; thus, on a rainy day, the heating may cancel out the cooling.

Paraffin.—The great advantage here is that there is a ready supply available. Unfortunately, paraffin has so high a boiling-point that, taken in conjunction with a mediocre latent heat, its cooling effect is insignificant. Its famous scouring action is, however, very beneficial to the whole power plant, of which fact more later.

Sulphur Dioxide, Nitric Acid, Nitrous Oxide, Benzene, and Turpentine.—All these are "possibles" with low boiling-points and fair to good calorific values, and they are readily available in a pure state. All, however, suffer from the drawback of very poor latent heat, quite apart from their generally undesirable qualities—some, in fact, would clearly ruin an engine in a few minutes, though all have at some period been considered as possible coolants.

Cost and bulk-availability will always be the deciding factors in choosing the normal injectant. It must be remembered that, although the cooling liquid may not comprise more than one-twentieth of the total flow by weight, and a far smaller proportion by volume, the total throughput of a big gas turbine is so enormous that the bulk of coolant required for any useful period assumes formidable proportions. It has, in fact, been found that at least half of any operational coolant must be water.

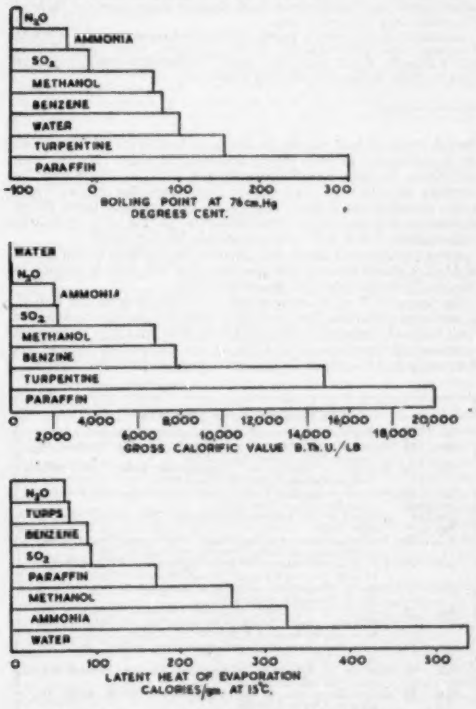


Fig. 2. Important physical properties of possible injectants.

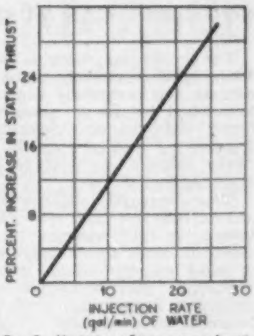


Fig. 3. Variation of percentage boost with injection rate: General Electric I-40, with pure water injection.

Before we go on to study results obtained it must be appreciated that security must compel the drawing of a veil over all present experimental work. We may, however, note that most of the liquids specified as "possible" have, in fact, been tried in actual installations, and generally found wanting.

First of all, research upon the injection of plain water has taken place in almost every country. Shortly after the end of the war, experimental results began to be made available. As example of these early results, the following figures from Power Jets (Research and Development), Ltd., may be quoted: using an elderly Whittle W2/700 double-sided centrifugal pure-jet engine, a water injection rate of 102 lb/min (i.e., approximately 4 per cent of the total mass-flow) gave a thrust increase of 18 per cent. In the U.S.A. a full report on trial injections of plain water was published in 1947 (Ref. 1). The trial concerned a General Electric I-40 (U.S.A.F. designation J-33) engine installed in an early Lockheed F-80A; being of Whittle descent, this unit had a double-sided centrifugal compressor. The straight-line relation obtained between injection rate and thrust increase is shown in Fig. 3. It was found that the maximum injection rate of 26 gal/min lowered the intake temperature by 20 to 30 deg F, indicating that between one-ninth and one-sixth of the water was evaporating. These results are no doubt to be considered poor by present standards.

A great deal of time has been given to experiments with ammonia, and some very great thrust-increases recorded. Though they refer to work done several years ago, the following results, again from Power Jets, may be quoted as examples. On a Whittle W.1, Mk III, a neat-ammonia injection equal to 6.15 per cent of the total flow by weight resulted in a net thrust increase of 28 per cent. The same report (Ref. 2) shows that on a W2B engine (early Rolls-Royce Welland) a net thrust-increase of 22.4 per cent was obtained for an ammonia injection of only 4.4 per cent. A different source (Ref. 3) quotes the interesting result of a "negligible" thrust-augmentation when a 5 per cent ammonia injection was used in conditions of high atmospheric humidity; this, of course, was due to the previously mentioned ammonium-hydroxide formation, with resulting liberation of heat. The greatest published thrust increase with coolant injection is a gain of 41 per cent (against a theoretical 57-58 per cent from a 10 per cent ammonia injection; in the author's opinion, however, this figure is of academic interest only; certainly a 10 per cent ammonia injection is most unlikely ever to become standard operating procedure).

Turning finally to methanol and methanol-water mixtures, there is little published information upon the result of past experiment. This may be because they are clearly the most useful liquids for this purpose and are of great operational importance, while the previously quoted results may largely concern work which has since been abandoned. Suffice to say that research upon their use is being carried out by both private firms and Government establishments in a great many countries, and that water-methanol injection is already a standard operating procedure on all kinds of turbine-powered aeroplanes, including such diverse types as heavy bombers, carrier fighters and turboprop airliners.

BOOSTING GAS TURBINES . . .

The present-day coolant is usually water, with methanol added up to 40 per cent of the total volume. The actual mixture must be carefully prepared and controlled, for it has been found that, for any given engine type, there is a "best brew," which may be of different strength from the mixture specified for another type. In fact, failure to supply the correct mixture may result in an engine over-running its operating limits.

When the required water-methanol mix has been made up and carefully filtered, it is stored in bulk in much the same manner as fuel, underground storage being planned at important airports. A supply is also, of course, available at many military airfields and on carriers. The actual "refuelling" may be carried out by hand on a fighter, although it is sometimes worth while assigning a complete bowser to water-methanol. In this connection, one may find the bowsers of one airfield filled with petrol, kerosine and water-methanol, although it is unlikely that an aeroplane would receive the wrong stuff.

In some large aircraft the total water-methanol capacity may run into hundreds of gallons, the tankage being put in any convenient spaces. From the tanks, the coolant is usually piped under low pressure to the appropriate part of the power plant. The actual details of any particular installation may not be given, but, knowing that the chief object is to obtain the finest spray in the beginning of the compression stage, it is quite easy to get a broad idea of a typical arrangement. A high-pressure spray may be used in the engine intake, blowing upstream or downstream and giving a spray rather similar to that of the main fuel jets in the combustion chambers. Alternatively, if the coolant can be brought to the inside of the compressor rotor, the enormous centrifugal load on the rapidly revolving liquid results in a very fine spray from any point of escape. To this end there may be a row of fine holes drilled radially around the compressor, in an early stage of an axial, or between the curved guide vanes of a centrifugal. This arrangement is somewhat akin to the fuel atomisation on M. Szydlowski's little Turboméca engines.

The dense spray resulting from injection has a great cleansing effect on the whole gas-path, as briefly mentioned earlier. In fact, the use of water-methanol often results in measurable increase in performance during the periods when injection is not taking place. This is especially true of axial engines, with their great compressor-blade area, but even the Rolls-Royce Dart (two-stage centrifugal), when no injection is used, loses about 2 per cent power in 250 hours by reason of dirt (Ref. 4). It is quite possible that injection may become a regular part of turbine airliner operation, whether or not it is essential for power-boosting. In any case, water-injection control, main engine-power lever and torquemeter are certain to be coupled together in order to ensure that full power is always available automatically without bothering the pilot. This is being done on the production Viscount (Ref. 5).

It must be remembered that not all the compressor air goes through to the combustion chambers. A proportion may be tapped off to cool the turbine bearing (this recalls the earlier mention of ammonia-copper trouble). A more serious problem is provided by cabin pressurization. There has long been discussion about the advisability of tapping all cabin air from a gas-turbine compressor. This is fairly easy on a fighter, and de Havillands have shown that it can be done on a big airliner as well. Coolant injection, however, if upstream of the cabin-air bleed (as it certainly ought to be), produces frightful problems. Even a slight increase in cabin humidity will fog windows, annoy the crew and passengers, and eventually produce a surprising amount of rusting and upholstery deterioration if continued. All this is assuming the presence of pure water; allow a trace of methanol in passenger-cabin air, and I doubt if even an airline stewardess could cope with the situation. The obvious solution is not to use cabin pressure until well after take-off; but perhaps we have said enough to show that there is quite a lot to this water-injection on turbines. One day, perhaps, we may see liquid-air injection.

REFERENCES

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(2) and (3) H. Roxbee Cox : Wright Memorial Lecture, 1945 (published in the 1946 vol. of the *I.Ae.S. Journal;* summarized in *Flight* of December 20th and 27th, 1945.
(4) and (5) R. N. Dorey : paper, "Extended Life of Propellor Turbine Engines," read before the S.A.E. (U.S.), April, 1950. Published in full in *Esso Air World*, Sept.-Oct., 1950. Published in slightly abridged form in *Flight* of May 4th and May 11th, 1950.

CANADA'S COMETS

THE R.C.A.F. order for two de Havilland Comet Is was the subject of questions in the Canadian House of Commons recently. It will be recalled that these aircraft were ordered to provide transport personnel with training and experience in multi-engined jets, and to provide simulated high-speed bombing attacks. The two machines in question were originally ordered by France, but that country's option on them was allowed to lapse and Canada decided to buy after Mr. C. D. Howe, Minister of Defence Production, had been given a demonstration flight. In addition to the two Comets, eight spare engines have been ordered. The first complete machine is due for delivery in December, and the second by March, 1953.

Col. Drew, Leader of the Opposition, asked about the expenditure of about two million dollars of public money on Avro Canada Jetliners. Mr. Mackenzie said that money spent to develop the Jetliner had meant the building up of an industry that could now produce jet fighters. The Jetliner programme had not been scrapped, but had been set aside. Any further expenditure on the Jetliner would have an effect on the output of CF-100s. Mr. Mackenzie pointed out that the Comets have a range of 3,450 miles as compared with the Jetliner's 2,000 miles. Col. Drew wanted to know if Canada was going to order bombers and train bomber crews, to which Mr. Mackenzie replied : "No decision has been communicated to our Department to order jet bombers."

Since this discussion took place, B.C.P.A. have ordered six Avon-Comets.

F/L. MASSEY-HILTON'S APPOINTMENT

THE recent appointment of F/L. L. Massey-Hilton, D.F.C., A.D.C., A.F.R.Ae.S., as an assistant managing director of the Fairey Aviation Co., Ltd., was referred to last week, when we published a portrait.

F/L. Hilton's career has been divided between the Services and the industry. He spent the latter part of World War I as a R.N.A.S. officer engaged upon deck and turret flying. He transferred to the Royal Air Force upon its formation on April 1st, 1918, and served actively for the following 13 years. He was with the North Russian Relief Force during 1919, in which year he received his D.F.C. F/L. Hilton then spent the ensuing eight years carrying out a great amount of experimental naval flying at various ship and shore establishments; at this time, it will be remembered, the R.A.F. was responsible for such work.

After the award of the A.F.C. in 1927, he performed staff duties at H.Q. Coastal Area before spending his last year of service in No. 41 (F) Squadron as a flight commander.

In April, 1931, at his own request, he retired from the R.A.F. in order to undertake Service liaison work for the Fairey Aviation Co., Ltd. Appointed a director of the firm in 1934, he became technical director in 1940 and supervised the development of the Barracuda and the entire design and development of the Firefly.

FORTHCOMING EVENTS

Jan.	11.	A. and A.E.E., Boscombe Down: Contractors' Dinner.
Jan.	18.	Helicopter Association: "A Review of Helicopter Patents," by Lt. Cdr. P. G. Satow, D.S.C., R.N.
Jan.	18.	Institute of Navigation: "Navigational Errors," by W/C. E. W. Anderson, O.B.E., D.F.C., A.F.C.
Jan.	19.	Aircraft Recognition Society: Hurricane Trophy Competition.
Jan. 19-20.		Vintage Aeroplane Club: Rally.
Jan. 28-Feb. 1.		Institute of the Aeronautical Sciences: 20th Annual Meeting, New York.
Jan.	29.	Society of Instrument Technology: "Mechanical Consideration in the Design of Servo Systems," by Prof. A. Tustin.
Jan.	31.	R.Ae.S. Section Lecture: "Problem of Short-haul Air Transport," by T. W. Brooks, B.Sc., A.C.G.I., A.F.R.Ae.S.
Feb.	7.	R.Ae.S.: "Availability and Use of Aeronautical Information" (Joint Discussion with ASLIB).
Feb.	11.	Institute of Transport: Brancker Memorial Lecture: "The Flying-boat and its Place in Aviation," by Air Chief Marshal Sir Frederick Bowhill, G.B.E., K.C.B., C.M.G., D.S.O.
Feb.	14.	R.Ae.S. Graduates and Students Lecture: "Radar," by D. W. Hodlin, B.Sc.
Feb.	15.	Institute of Navigation: "Navigation Aids for Military Aircraft," by S/L. D. Bower.
Feb.	20.	British Institution of Radio Engineers: "Search Radar for Aircraft," by P. L. Scride.

The ENGLAND to NEW ZEALAND RACE

Indications of Encouraging Support : Problems Involved in Planning the Route

As mentioned briefly in *Flight* last week, two of the organizers of the 1953 England to New Zealand race, Mr. Hume D. Christie and Mr. John Stannage, recently visited America, and they have since come to this country for discussions with the Royal Aero Club and various other interested parties in order further to advance the stage of planning which has been reached.

The fact that the entry forms will be published this month will naturally tend to awaken new interest in the event (which is now only 18 months distant) and there is certain to be a great deal of speculation on such subjects as prospective entrants and actual route to be followed. On neither of these points can any reliable forecast be given at this stage, but concerning the former, Mr. Christie has told us that the total number of entries is likely to amount to a very substantial figure. The American airlines are showing particular interest in the race, as are several U.S. manufacturers. It is probable, too, that several entries may be forthcoming from the U.S. Air Force. Mr. Christie informs us also that a number of well-known American amateur racing pilots —among them Paul Mantz, Jacqueline Cochrane and Diana Bixby—may compete.

Because a minimum average speed of 77 m.p.h. must be maintained over the whole course, and the start-to-finish time must not exceed 168 hours, it seems probable that nothing very much smaller than a Dakota will be flying in the Handicap Class. Even so we understand that there have been inquiries from the owners of a Dove and a Beechcraft Twin-Bonanza. The latter machine has—with additional tankage—exceptionally good range characteristics, and, as it cruises at around 200 m.p.h., it might conceivably stand a good chance. Although the handicap formula does take into account the number of refuelling stops made the advantage is still likely to lie with the aircraft making the fewest stops. For the Handicap Class a number of what might be termed "firm inquiries" have been received; among them are B.O.A.C., B.E.A., Q.E.A., K.L.M., de Havilland and Armstrong Whitworth.

The Speed Class is likely to encourage the entering of a variety of high-speed fighter-type aircraft either jet- or piston-engined. In the latter category, the range requirements may entice several Mustang owners to enter. The organizers say that in general they are very encouraged by the interest which has so far been shown by prospective entrants, although it is still far too early even to guess at the eventual length of the starter's list.

The question of control points and the precise course (or courses) over which the race will take place is now receiving the attention of the planning committee and some idea of the problems involved in deciding these points can be obtained from the following extracts from an article by Douglas Scoffham, D.F.C., who is already well-known in British racing circles and who will be closely connected with the operational side of the race :—

One of the first questions (he writes) asked of the Canterbury International Air Race Council when the Royal Aero Club agreed to co-operate in organizing the race was, "Do you wish to have any control points at which competitors must land and check in?" In the MacRobertson England-Australia Race, in 1934, there were control points at Baghdad, Allahabad, Singapore, Darwin and Charlesville, which were airfields where competitors had to land and report. In addition, the Handicap Section of the race had 18 "authorized checking points" situated approximately every 500 miles along the course. It was not necessary to land at all or any of the checking points and it was permissible to put down at places between control points and checking points, although the time spent on such landings would not be taken into account for handicapping purposes. The object of the control points was to ensure that all competitors flew over the same course; that the pilot had not been changed; that no personnel had been disembarked without replacement; that the aircraft was supplied with emergency rations, lifebelt and distress signals; that the amount of petrol and oil carried on board did not exceed the maximum permissible loading as stated in its C. of A.; and to ensure that all seals on the aircraft remained unbroken.

For the New Zealand race it has been generally agreed that there should be control points for the Handicap Section, but there are still some doubts about the Speed Section, particularly if flight refuelling is to be allowed. The organization of a control point is a major problem and also a large financial liability, so the aim is to reduce the number of such stops to as few as possible. It is felt that control points, if any, should be on British territory and preferably at an R.A.F. airfield or one at which there is a flying club, so that expenditure can be kept to a minimum. Unless control points are established a handicap formula will be extremely difficult to operate, even if it is possible at all. Without them it will be impossible to check that the conditions of the race are being observed. If, on the other hand, flight refuelling were to be used, it would be pointless to specify landings at control points, and perhaps a system whereby aircraft report by R/T or other approved means can be operated.

Unfortunately, even this would not be infallible, as it would necessitate losing altitude, might confuse radio reception at airports in such a way as to endanger normal traffic, and might also permit a certain amount of "clipping" on control points. For example, after Cyprus had been passed there would be insufficient facilities at aerodromes on the course to give adequate radar coverage to prevent "corner-cutting."

Most of the aircraft entering the race, except in the Speed Section, will probably be types intended for airline use and, therefore, should meet conditions obtaining on recognized routes. In this case, control points at Basra, Calcutta, Singapore and a point somewhere on the east coast of Australia would be effective. If, however, these four control points were used for the Handicap Section and were made compulsory, aircraft might be prevented from entering for both sections of the race and the chances of long-range aircraft would also tend to be prejudiced. A further factor which must be considered is that in order to avoid any risk of international friction it is thought desirable that competing aircraft should not fly over Russian-dominated countries and that control points should be established to eliminate any possibility of this happening. The main problems can, therefore, be summarized as follows : (i) control points should be used, but must be kept to a minimum number to ensure that all competitors fly substantially the same course; (ii) the course should avoid Iron Curtain territory; (iii) the course should, as far as possible, avoid long over-sea crossings; (iv) there should not be too great a disparity between the distances flown by long- and short-range aircraft.

Obligatory Landing at Basra

From this, it would appear that two control points might suffice, namely, Cyprus, Castel Benito or Malta as the first and Karachi as the second. The Great Circle track from Calcutta to Singapore approximates very roughly to the trunk route and provides adequate intermediate stopping-places for short-range aircraft. Long-range types could probably fly direct from Karachi to Singapore, saving approximately 200-300 n.m. The distances to these first points would prejudice long-range machines, however, and a compromised solution has, therefore, been found in the choice of one control point—an obligatory landing—situated in the Basra area.

The Basra area contains many aerodromes and, in addition, has a water alighting point so that there is a choice of facilities for large aircraft. Aircraft however would still pass over a section of the Iron Curtain, but the additional distance entailed by deviating south of these countries is of minor importance. The G.C. track from Basra to Christchurch crosses the Bay of Bengal and passes over the Andaman Islands direct to Singapore. The majority of aircraft would probably fly Basra to Rangoon, in which case they would follow the route taken by the shortest-range aircraft.

Finally, Basra would normally be a refuelling point for all aircraft whether they be short- or long-range. It has, therefore, been decided that an "intermediate control-point" will be established in the general region of Basra; the exact location will be announced later. In choosing the actual airfield the following factors must be considered: (i) the length of the longest runway must be at least 2,000yd; (ii) the bearing strength should be adequate (i.e., up to, say, 300,000lb all-up weight with a tyre pressure of 90lb/sq. in.); (iii) the airfield must comply with international regulations governing the performance of aircraft both landing and taking off; (iv) it must have suitable meteorological conditions in October; (v) it must be in an area which will be politically stable in 1953, have a water aerodrome nearby, and have adequate facilities for accommodation, control, maintenance, refuelling, and communications.

Airfields which could have been used, such as Abadan and Dhahran, may now prove impracticable due to the political situation. Shaibah, Basra-Margil and Baghdad have not the necessary bearing strength—R.A.F. Station Habbaniya would comply with most of the conditions, but its political future is obscure.

It may be necessary, therefore, to consider places such as Teheran, Entebbe or even Khartoum. But while the first causes the route to encroach further over the Iron Curtain countries, the other two may tend to give the advantage to the long-range machines over the shorter-range competitors, who would have to pass up the Persian Gulf to Karachi.

NEW YEAR HONOURS

Recipients in the Aviation Community: A Further List of Names

LAST week we published a brief list of the New Year Honours, which had been announced as we went to press, while on our "Service Aviation" page we were able to give the names of the majority of R.A.F. recipients. On this page is a more detailed list of—mainly—civil honours, together with portraits of some of the senior officers named last week.

Capt. O. P. Jones, B.O.A.C.'s most senior captain, becomes a C.V.O.; he recently had the honour of commanding the Stratocruiser which carried T.R.H. Princess Elizabeth and the Duke of Edinburgh to Canada. Two distinguished aeronautical scientists, Prof. Leonard Bairstow and Mr. D. R. Pye, receive Knighthoods. Though no longer actively connected with aviation Sir Archibald Sinclair—who becomes a Viscount—will be remembered as Secretary of State for Air during the war years.

The remainder of the Service honours, additional to those previously quoted, are listed on page 55.

KNIGHTS BACHELOR

Professor Leonard Bairstow, chairman, Aeronautical Research Council.

S/L. E. H. Keeling, M.P. for Twickenham since 1935.

D. R. Pye, lately Provost of University College, London University; Director of Scientific Research, Air Ministry, 1937-43.

ORDER OF THE BATH

C.B.

E. A. Armstrong, Under-Secretary, Ministry of Civil Aviation; R. H. Melville, Assistant Under-Secretary of State, Air Ministry; L. H. Robinson, Under-Secretary, Ministry of Supply.

ROYAL VICTORIAN ORDER

C.V.O.

Capt. O. P. Jones, senior pilot, B.O.A.C.

M.V.O. (FIFTH CLASS)

F/L. W. T. Bussey, R.A.F. ret.; Lt. (S) K. Hall, R.N. ret.; E. A. S. Mitchell; S/L. H. A. Nash, R.A.F.; G. O. Peskett; F/L. S. N. Sloan, R.A.F. ret.*

**Captain of these names were quoted in our list of Service Honours last week.*

ORDER OF THE BRITISH EMPIRE

K.B.E.

Lewis B. Hutchinson, Deputy Secretary, Ministry of Supply.

C.B.E.

G. L. Bailey, director of research, British Non-Ferrous Metals Research Association; J. P. Berkin, manager, Shell Petroleum Co., Ltd.; H. H. Burton, director, English Steel Corporation, Ltd.; W. Deane, Assistant Secretary, Air Ministry; D. G. Hooper, Assistant Secretary, Ministry of Supply; W. Lappin, Rolls-Royce, Ltd. (liaison officer with R.A.F. and Government departments); H. L. Stevens, Principal Director, Equipment Research and Development (Air), Ministry of Supply; W. W. Withers, member of council, R.A.F. Benevolent Fund.

O.B.E.

P. E. Bewshea, sales manager, North America, B.O.A.C.; G. L. Gandy, divisional operations officer, Ministry of Civil Aviation; E. C. Godwin, superintendent, Architectural Section, Directorate of Works and Buildings, Air Ministry; H. Harvey, principal, Air Ministry; Col. P. R. W. Hunt, chief technical adviser, Vickers-Armstrongs, Ltd., London; W. H. G. Lake, works manager, I.C.I., Ltd., King's Norton; A. H. Searl, lately Director of Non-Ferrous Metals, Ministry of Materials; G. W. Wallis, principal, Air Ministry.

Sir Archibald Sinclair (Viscount)

Prof. Leonard Bairstow (Knight Bachelor)

Air Chief Marshal Sir W. F. Dickson (K.C.B.)

Air Marshal A. C. Stevens (K.B.E.)

Air Chief Marshal Sir L. Hollinghurst (G.B.E.)

Air Chief Marshal Sir A. P. M. Sanders (K.C.B.)

S/L. H. A. Nash (M.V.O.)

Mr. W. Lappin (C.B.E.)

Capt. O. P. Jones (C.V.O.)

M.B.E.

F. J. Chard, production manager (Brabazon Project), British Aeroplane Co., Ltd.; Miss A. M. Coleman, higher executive officer, Ministry of Civil Aviation; J. A. Hamilton, senior scientific officer, Marine Aircraft Experimental Establishment, Ministry of Supply; C. J. Hayward, standards engineer, B.O.A.C.; F. G. Henson, air-traffic control officer, Ministry of Civil Aviation; W. A. L. Marshall, senior experimental officer, Meteorological Office, Air Ministry; H. F. Morton, chief works engineer, de Havilland Propellers, Ltd., Bolton; Obs. Cdr. W. A. Nimmo, Commandant, No. 35 Group, Royal Observer Corps, Oban; S. F. Perry, manager of experimental department, Vickers-Armstrongs, Ltd., Winchester; F. S. Rae, higher executive officer, Air Ministry; J. R. Riddell, hon. secretary, No. 1119 (Shrewsbury) Squadron committee, A.T.C.; R. G. Sprules, senior executive officer, No. 35 Maintenance Unit, R.A.F.; Miss D. Trewhitt, executive officer, Air Ministry; G. B. Vale, higher executive officer, Ministry of Supply; H. H. White, area superintendent (North Nigeria), West African Airways Corporation.

BRITISH EMPIRE MEDAL (CIVIL)

C. J. de Bourde, senior assistant (scientific), R.A.F. Station, Chigwell; W. P. Elton, chargehand joiner, Royal Aircraft Establishment, Farnborough; J. F. Erlam, clerk of works, Northolt Airport; P. V. Fisher, principal foreman, No. 35 Maintenance Unit, R.A.F.; S. J. Moore, non-technical Grade IV, Aeroplane and Armament Experimental Establishment, Boscombe Down; F. G. Morgan, semi-skilled labourer, No. 11 Maintenance Unit, R.A.F.; Pak Chau Ng, clerk, Grade I, R.A.F., Kai Tak, Hongkong; S. H. Sawyer, civilian W.O., No. 418 (Conway) Squadron, A.T.C.; W. S. Walker, general foreman, Turnhouse Airport; J. C. W. White, civilian W.O., No. 275 Squadron, A.T.C., Monmouth.

EMBARKATION

by Ray Nockolds

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POWERED BY TEN BRISTOL PROTEUS ENGINES

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VAMPIRE NIGHT FIGHTER

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VENOM 2 NIGHT FIGHTER

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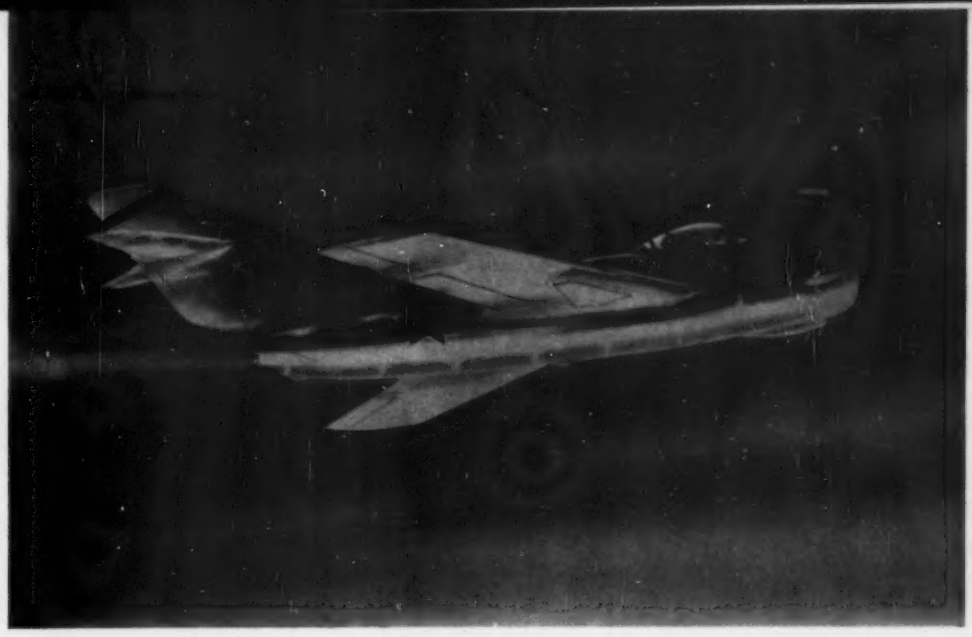
high-altitude combat and gunnery,
ground-attack with rockets and bombs,
high-speed navigation,
and handling experience at high Mach numbers—
and if need be it can be employed on operations.

DE HAVILLAND

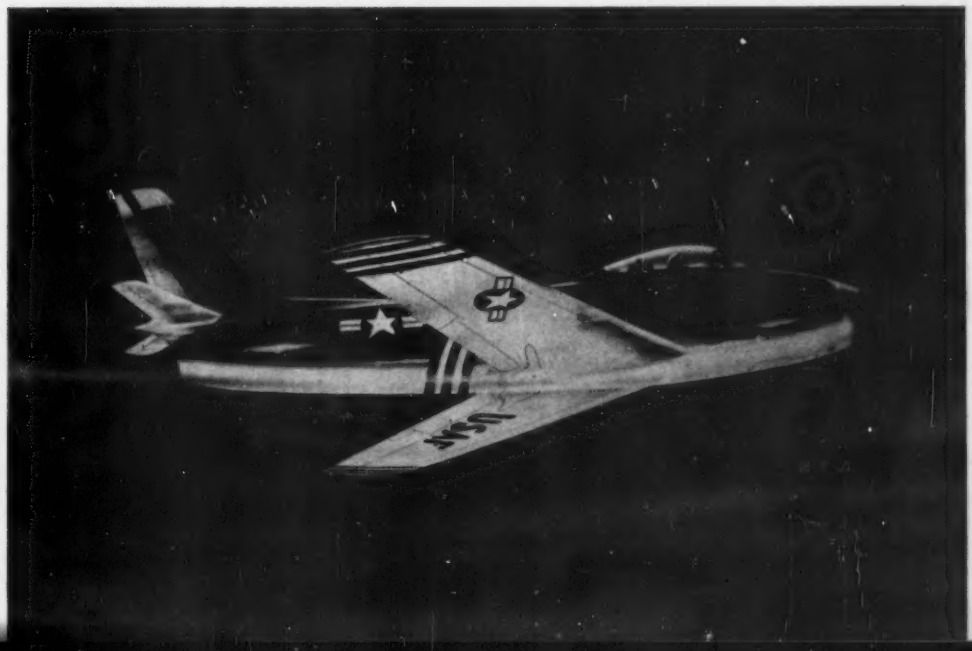


MIG *versus* SABRE

FOR direct visual comparison of the Mig-15 and North American F-86 Sabre the *Flight* drawings on this page have been specially prepared. It will be judged that the Mig (above) is somewhat inferior aerodynamically, having large "blister" fairings over its guns; nevertheless, it is reported from Korea that at heights above 32,000ft all Migs are faster than the F-86, and that some are superior down to 20,000ft. This may well mean that the turbojet installed in one version approximates in output to the Rolls-Royce Nene, of 5,000 lb thrust, but that a newer model has a power unit at least as powerful as the Tay (6,250 lb).

Whereas the F-86 mounts an armament of six 0.5in guns, the Mig is reported as having one large-bore gun (30 or 37 mm) and two 20 or 23 mm weapons. Prime factors in the Sabres' consistent victories over large formations of Migs are the excellent training of the American pilots and the radar gun-sight now standard in the F-86.

Writing from Korea, Mr. A. W. Jessup, of *Aviation Week*, says that the nationality of the Mig pilots is still unproved. "For all we know," one Sabre pilot of the 4th Fighter Interceptor Group is reported as saying, "there may be some ex-American World War II fighter jockeys up there."



FOR HIGH-MACH TUITION

TO the pupil fighter-pilot about to enter the final stages of his training, anticipation is often alarming; realization is hardly ever so. That this is the case is largely due to the viceless flying qualities of the Gloster Meteor T.7 and Lockheed T-33 shown in the upper left and upper right photographs respectively. Both have performed sterling service over the past few years, and are a long way from retirement. The T-33, in fact, is about to go into production at Canadair, powered by a Rolls-Royce Nene.

Conversion of an aircraft from a fighter to a trainer has, however, been born of necessity, and must generally result in the trainer having shortcomings. One of the more obvious is the difficulty of providing side-by-side seating which, on this side of the Atlantic at least, is generally thought preferable.

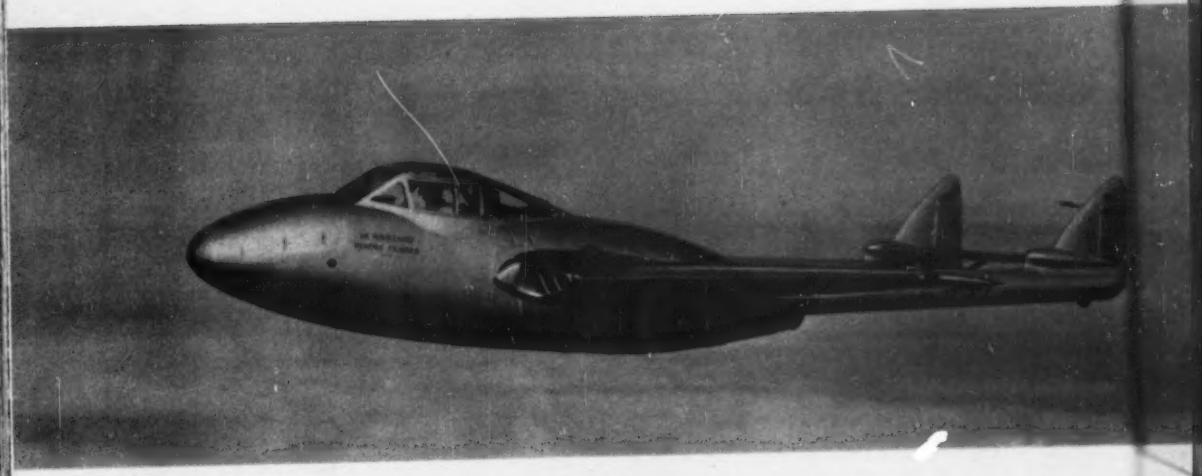
De Havilland's have, however, managed to arrange such accommodation in the Vampire Trainer (centre right), now about to enter service with the R.A.F. and certain foreign air forces. This trainer has, in fact, a cockpit wider than that of the Mosquito, although performance has not suffered in consequence. Credit for this very neat conversion is due to the company's Airspeed division.

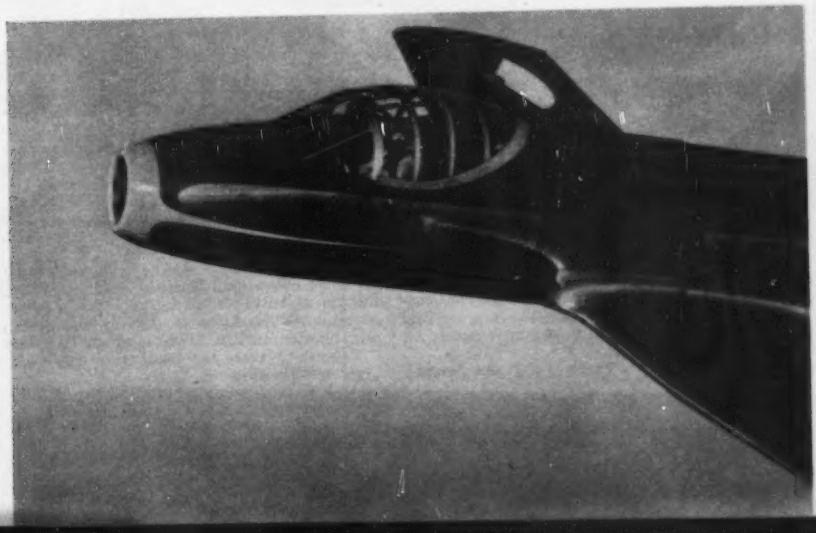
The two lower photographs show, on the left, the Fiat G.80 Goblin-powered trainer from Turin, and on the right, the Fokker S.14, Derwent-powered, from Amsterdam. Apart from their power plants, both these aircraft use a great deal of British equipment. It will be remarked that, although both were designed as trainers from the outset, the Italian machine features tandem cockpits.

Emphasis in their design has been placed upon economy of operation and easy handling, especially at low speeds.

It may be remembered that a medium-powered design in the class of the Italian and Dutch trainers is projected by Boulton Paul Ltd., under the designation P.119. An elaborate mock-up of this aircraft, complete with a real Derwent turbojet, was illustrated in *Flight* of August 31st, 1951.

GQ-D





MORE ABOUT THE GANNET

Attributes and Equipment of its Double Mamba Turboprop

PRESENTING for popular consumption what may be termed the case for the Double Mamba installation in the Gannet, the Fairey Aviation company make one or two observations that are well worth recording; they also indicate certain developments which have been taking place, particularly in connection with turboprop operation. First, however, it may be mentioned that the aircraft is still undergoing certain changes, as observers in the White Waltham area will have noted. For example, additional fins have been sprouted on the tailplane tips. Until the form of these modifications has been finalized Faireys prefer to make no reference to them, and the same remark may be made of the main fin and rudder and of the cockpit enclosures.

In the statement it is emphasized that the Double Mamba is at the beginning of its development life, and that Armstrong Siddeleys are confident that they will be able to obtain greatly increased power with reduced specific fuel-consumption. It is pointed out that improvements will be obtained without sacrificing the life and durability of the engine because they will be achieved by improving efficiency and not by "running the engine hotter."

When the Gannet is engaged on search operations normal cruising conditions entail the use of only half the Double Mamba, and thus the effective life of the engine which is shut down is prolonged. In comparable circumstances a piston engine continues to use up its available life however much it may be throttled back, because all its parts keep moving.

Because turboprops are not yet in full service it is not possible to provide maintenance statistics based on actual experience. However, from knowledge of turbojets and a great deal of flying with turboprops it is estimated that, as compared with piston engines, gas turbines require approximately half the maintenance man-hours per flying hour. Moreover, the makers see no reason why the overhaul period and ultimate life of turboprops should not be at least as great as those of piston engines. Care has been taken to maintain interchangeability of parts in the two halves of the Double Mamba, so that there need be no increase in the number of spares that would normally be held.

Apart from the fatigue-reducing advantages afforded to the Gannet's crew by low noise and vibration levels, a very great improvement in instrument serviceability and life can be expected. This will not only affect operational availability of aircraft, but may be expected to improve their efficiency while flying on operations. The importance of obtaining longer life and less maintenance of instruments cannot be over-estimated.

Some time ago mention was made of the experimental running of a Mamba using alternative oil fuels. That such development work began some time ago is confirmed in the statement which adds that aviation petrol, wide-cut petrol, diesel oil and other fuels more readily available in quantity than kerosine are in mind. It is added that, because of their higher flash-points, heavy oils are much safer than petrol in the event of crash landings either on the deck of an aircraft carrier or ashore.

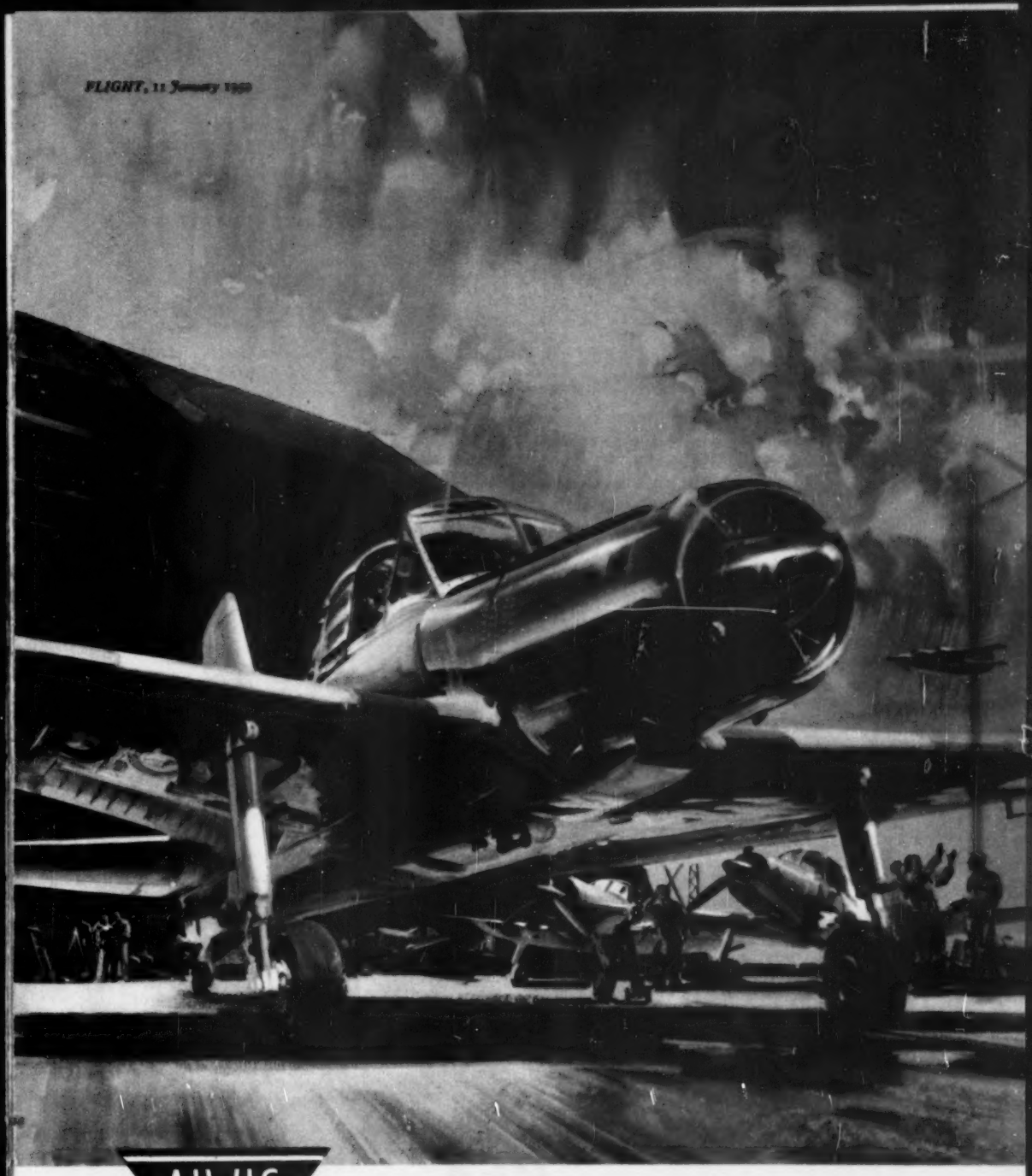
Miscellaneous items of information include the statement that the turbine engine does not show flame visible from the rear of the aircraft when flying at night, and in the case of the Gannet the curvature of the jet-pipe prevents even the glow that there might be from internal hot components. Highly boosted piston-engines are, by comparison, most difficult to flame-damp effectively. The Mamba incorporates reverse-torque mechanism which is, in effect, an automatic airscrew-feathering device. It automatically reduces the drag of a windmilling airscrew as quickly as possible, and will minimize the loss in height or speed which occurs while the stationary half of the engine is started up and accelerated in the event of the other half failing. Common enough on commercial aircraft, but unusual in the Services, is the provision, on the Double Mamba, of a torquemeter as standard equipment. This provides the pilot with the means of knowing the power output of either half of the engine at any time. Incidentally, each half of the unit is controlled by a single pilot's lever, the fuel and airscrew systems being interlinked.

Water-Methanol Injection

On the subject of overseas operations reference is made to the loss of power in hot climates. Water-methanol injection is, however, being developed as a standard fitting for the Double Mamba, and with its aid the loss in output can be largely restored.

In Arctic conditions the normal power output of the engine is appreciably increased. Experience has also indicated that the Double Mamba will start without oil dilution or any other special precaution with the oil at —15 to —20 deg C. With the use of special oils appropriate to such conditions no starting trouble is anticipated at temperatures down to as low as —40 deg C.

It is not made clear whether steel blades will be fitted to the compressors of all Mambas, but it is considered that with the aid of such blades the engine will operate in sandy conditions without trouble. During some tests 35 lb of sand was injected into a Mamba which had only light-alloy compressor blades, and the engine continued to function quite satisfactorily.



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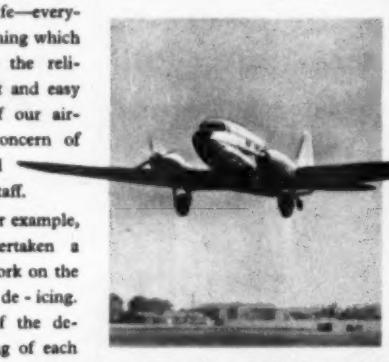

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BEA

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FLUTTER

Control Surface Problems Discussed in a Lecture to the Royal Aeronautical Society by E. G. Broadbent and W. T. Kirkby

PART ONE

IN presenting their lecture, *Control Surface Flutter*, before the Royal Aeronautical Society on December 20th last, Mr. E. G. Broadbent, M.A., A.F.R.Ae.S., and Mr. W. T. Kirkby, A.F.R.Ae.S., A.M.I.Mech.E., each read personally that part of the paper for which he was primarily responsible. Both lecturers are Senior Scientific Officers in the Structures Department at the R.A.E.

Introducing the first part of the lecture under the heading "Theoretical Background," Mr. Broadbent said that in recent years it had grown customary for aircraft firms to put increasing effort into the prediction of flutter during the design stage. This design work, however, was chiefly related to wing flutter in which the control surfaces played little part, whereas the cases of flutter which most commonly occurred in reality were those involving control surfaces. The reason for this was that the wing stiffness, and hence the wing weight, was often determined by considerations of main surface flutter.

Control surface flutter, however, could often be prevented by methods which did not have a serious effect on the aircraft weight, and which were often postponed until after the design stage. It was the purpose of the lecture to discuss what steps could be taken both in the design stage and during the flight testing of a prototype to prevent control surface flutter. In many cases, a set of calculations made in the late design stage would save valuable time and effort during the flight testing of the aircraft. A thorough knowledge of the flutter properties of the system, moreover, might help towards a much quicker cure of flutter or allied vibration should either be met with in flight.

In general, such calculations should cover a wide range o variables with a few degrees of freedom (binaries or ternaries) rather than take the form of a single involved calculation with many degrees of freedom intended to give one final answer. No matter how many calculations were made, however, it was important to approach the flight testing of a prototype with an eye to the possibility of detecting incipient flutter. Arguments might be raised that anything in the nature of flight flutter testing was dangerous, but the point was that all aircraft were automatically flutter-tested in some degree in the normal process of routine flying. Any warning of the onset of flutter was worth having and, in the authors' opinion, to obtain such warning should be a recognized objective in planning flight trials.

An important feature which should always be borne in mind when discussing control surface flutter was that prevention of flutter should be the aim irrespective of known flight limitations. This was a general precaution and was based on experience that the accuracy with which flutter could be predicted was much greater in terms of structural parameters (such as mass balance) than in terms of air speed. It was not always possible to follow this rule, but with most simple designs it could be done.

Notation

ω—frequency of oscillation.
I_c—control surface inertia.
V—forward true air speed.
ϱ—air density.
$-H_\theta$—control surface aerodynamic stiffness coefficient (involving the derivative $-h_\theta$ or $-b_2$).
E—elastic restraining stiffness of the control circuit.
α—angle of incidence.
β—deflection of control surface.
l_β or a_3—non-dimensional derivative giving rate of change of lift with β.
$m_{\dot{\alpha}+\alpha}$—non-dimensional derivative giving rate of change of moment about leading edge with rate of change of α.
m_β—non-dimensional derivative giving rate of change of moment about leading edge with β.
h_α or b_1—non-dimensional derivative giving rate of change of hinge moment with α.
h_β or b_2—non-dimensional derivative giving rate of change of hinge moment with β.
t_γ or c_3—non-dimensional derivative giving rate of change of tab hinge moment due to tab displacement.
I_1—elastic stiffness of powered control circuit.
I_2—damping of powered control circuit.
t—time.

The type of flutter first considered was that of a single flap mounted on a main surface. Flutter usually arose with one of two kinds of main surface motion, and these two kinds were typified by wing-bending aileron flutter and wing-torsion aileron flutter. In wing-bending flutter, the motion of wing chordal sections was translational and of large amplitude at the aileron, giving considerable displacement to the aileron hinge line. In wing-torsion flutter, the motion of wing chordal sections was pitching in character, and the aileron hinge displacement was much less.

These two different kinds of flutter had certain distinct characteristics. Wing-bending was a type of motion which was heavily damped aerodynamically, and this gave rise to a large positive damping determinant in the bending-aileron flutter equations. In these circumstances, flutter could arise only from a powerful source of excitation. This source existed if the aileron c.g. was well aft of the hinge line, as this permitted the powerful lift term from the aileron (l_β or a_3) to excite the wing motion. On the other hand, this coupling, and with it the existence of flutter, was readily destroyed if the aileron c.g.—including virtual inertia effects—was brought up to the hinge line.

In torsion aileron flutter, the position was no longer a clear fight between two powerful adversaries. The damping determinant was now comparatively small, but so also was the source of excitation. These two effects could be seen by the fact that the

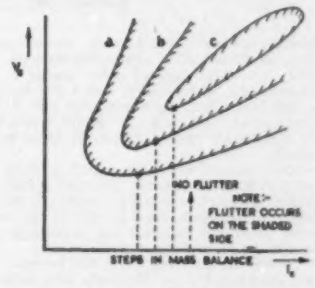


Fig. 1. Variation of critical flutter speed with control surface moment of inertia.

two-dimensional incompressible value of the wing torsional (aerodynamic) damping ($-m_{\dot{\alpha}+\alpha}$) vanished altogether if the nodal line ran at the three-quarter chord position, and also the exciting term ($-m_\beta$ or m) vanished if the nodal line ran at about the half-chord position. Thus, as compared with bending-aileron flutter, it was not so easy to say in advance whether torsion-aileron flutter would occur or not. A further complication was that torsion-aileron flutter occurred, if at all, at a higher speed than bending-aileron flutter, but it was then more difficult to suppress, because the inertia coupling was less sensitive to mass balance.

Fuselage-bending elevator flutter was related to both kinds of wing-aileron flutter. If the node in the fuselage was well forward, then it was more akin to bending-aileron flutter, whereas if the node was far back, it was similar to torsion-aileron flutter. Similarly, with rudder flutter, the fuselage and fin nodal points could vary in such a way as to give either kind of flutter.

A typical diagram of flutter speed plotted against control surface inertia was given in Fig. 1. Suppose curve (a) was for a control surface without mass balance. If the moment of inertia alone was increased from zero (a constant mass-moment was implied, not a constant c.g. position) there was at first a region of complete immunity from flutter. This was followed by a region in which flutter started at a lower critical speed, and then died out at a higher critical speed, possibly to be followed at still higher inertias by a region in which there was no upper critical speed. In practical cases, a large inertia was a bad thing, for although the lower critical speed might rise a little with increase in inertia, it was likely to remain within the flight speed range of the aircraft, and the severity of the flutter got worse as the upper and lower critical speeds became more widely separated.

Curves (b) and (c) showed the effect of reducing the product of inertia between the motions of the control surface and the main surface. The effect was strongly stabilising. Mass balance of the control surface normally achieved this effect although at the same

FLUTTER . . .

time it increased the moment of inertia, and flutter was eventually eliminated altogether.

Mr. Broadbent then went on to consider the variation of the control surface moment of inertia. The control surface forces due to control surface motion might be written as :—

$$\left\{-I_s\omega^2+\left(-H\beta\right)\rho V^2+E\right\}\beta\cos\omega t+$$
$$\left(-H\beta\right)\rho V\omega\beta\sin\omega t \quad . \qquad (1)$$

From this set of forces, it could be seen that an increase in I could be compensated for by a decrease in E and *vice versa*. Thus the effect of increase in the circuit restraining stiffness could be seen by moving to the left in Fig. 1; flutter was eventually eliminated. Furthermore, an increase in $(-h_3)$ or $(-b_2)$ had an effect similar to an increase in circuit stiffness and opposite to an

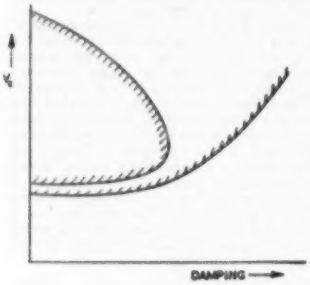


Fig. 2. Variation of critical flutte speed with artificial damping.

increase in control surface inertia. By analogy, it was to be expected that, for flutter of the torsion-aileron type, an increase in $(-h_0)$ or $(-b_1)$ would have an effect similar to an increase in mass balance and, in particular, that a positive h_0 or b_1 would have a very bad effect. In a particular case in which this had been investigated, the range of flutter was considerably increased by a reduction in $(-h_0)$, but the lower critical speed was also raised.

Very large or very heavy control surfaces, for which flutter was often difficult to suppress, deserved special mention. It was the relative density of the control surface to the air which was important here, and an increase in altitude had the same effect (at constant equivalent air speed and neglecting compressibility) as an increase in mass of the control surface.

Increase in damping could also be used to suppress flutter as was shown in Fig. 2. Normally, with sufficient damping, a condition was reached for which no flutter occurred but, again, for very heavy controls or at great heights, this was not possible. In this case, the effect of increase in height was to be expected, for if the equivalent air speed was maintained constant, it could be seen from equation (1) that the damping term was reduced by comparison with the others as the air density fell.

Dealing with the importance of nodal shape, Mr. Broadbent observed that it had long been recognised that the shape of the aircraft's normal mode in relation to the control surface mass balance weights was an important feature in deciding whether flutter would occur or not. The resonance test results were examined chiefly with the idea of deciding which modes were bad and which good from this aspect. It was current practice to make flutter calculations with the bad modes, but to pass over the good modes on the assumption that flutter would not occur.

The best way of avoiding trouble from control surface flutter was still to distribute the mass balance evenly along the leading

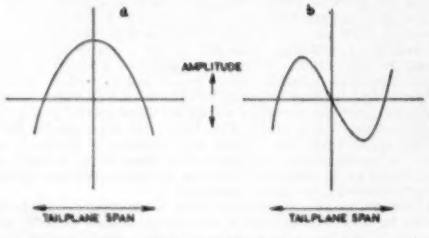


Fig. 3. Tailplane modes of vibration.

edge. Instances of control surface flutter with this type of mass balance were extremely rare—unless influenced by the presence of another degree of freedom—and that fact alone should be sufficient recommendation. Nevertheless, the possibility of flutter did exist, and it was important to know what features to look for in the resonance test results.

Assuming that the control surface was about statically balanced, for an aileron the most dangerous type of mode was one in which the nodal line ran along, or near, the wing leading edge. For elevators and rudders much the same applied, except that, in a dangerous mode, the nodal line lay a little ahead of the (tailplane or fin) leading edge. With such a mode, it was possible that static balance would be insufficient to eliminate flutter, but fortunately modes of this type were rare.

It was certainly uncommon for a wing nodal line to run along the leading edge; the chief danger lay in fuselage bending modes of the type that had a nodal point well back in the fuselage, e.g., just ahead of the tailplane leading edge. These modes were common enough, but fortunately were usually associated with considerable tailplane bending, as it was unusual for tailplane and fuselage bending frequencies to be widely different.

Elevators had been the chief source of control surface flutter incidents in recent years, and one of the main reasons had been the use of concentrated balance weights. It was undoubtedly convenient to split the elevator mass-balance into three parts, and to place part in each elevator horn with the remainder in the fuselage. This scheme of mass-balance was probably more common than any other for elevators. Superficially it appeared to do its job adequately, since it provided mass-balance both against vertical translation and roll of the tailplane, and as the mass involved was small because long balance arms were available, the arrangement was a popular one; but it left some common types of mode unprovided for. It was worse than distributed mass-balance for a fuselage bending mode with a "rigid" tailplane (admittedly uncommon) simply because the mass-balance arms were longer, and the weights were therefore nearer the node. It was also unsatisfactory for tailplane bending modes of the types shown in Figs. 3(a) and 3(b).

Fig. 3(a) showed a symmetric mode which could couple with elevator rotation, and in this mode the horn balance weights were acting the wrong way for the greater part of the elevator. It was possible that the centre-line weight, in spite of its full effectiveness, would be inadequate to suppress the flutter. Fig. 3(b) showed an anti-symmetric mode, and again the horn weights acted the wrong way. In this case, as with all anti-symmetric modes, the centre-line weight had no effect at all; on the other hand, the halves of the elevator had to twist against each other, and this motion was normally resisted by the torsional stiffness of the elevator itself and a stiff interconnection. If the elevator torsional frequency (one half against the other) was high, then the flutter speed associated with this type of mode would also be high. It might occur, however, within the flying speed range of the aircraft, and if so the flutter was likely to take a dangerous form because of the high stresses near the horn.

Rudder Flutter

Like the elevator, the rudder was also difficult to mass-balance adequately with concentrated weights. In addition, it was more difficult to pre-judge the result of flutter calculations on the rudder than on any of the other control surfaces. Flutter calculations on the rudder would often suggest that no mass-balance was needed in spite of a bad nodal line; this was usually caused by heavy aerodynamic damping of the associated wing and tailplane motion. The occurrence of rudder flutter in flight, however, was not unknown, even in recent years. Distributed mass-balance was the best safeguard.

Reference had already been made to the possibility of two normal modes combining together in flight in such a way as to give a mode more dangerous than either of the originals. A way in which this might lead to elevator flutter was indicated by Fig. 4. This showed two symmetric normal modes—(a) and (b)—near together in frequency with the wing amplitudes plotted on the left and the fuselage amplitudes plotted on the right. Either of these modes might give rise to elevator flutter, because of the aft nodal point in the fuselage, were it not for the heavy aerodynamic damping to be expected on the wing. If, however, the two modes combined, in flight, by direct subtraction (as plotted in Fig. 4), the wing motion would be greatly reduced without affecting the fuselage amplitudes. This possibility made flutter much more likely.

The same effect might occur in a more complicated way if the tailplane also resonated at a frequency near to those of the wing and fuselage, when three modes would be involved. The proper way to deal with these problems in analysis was to add an extra degree of freedom for each mode, but a short cut (first suggested by Professor Collar) could sometimes be employed. The short cut consisted of combining the two modes together so as to make the wing motion a minimum, and the inertia and elastic coefficients of the combined mode could then be calculated in terms of the known values for the original mode. Another complication that

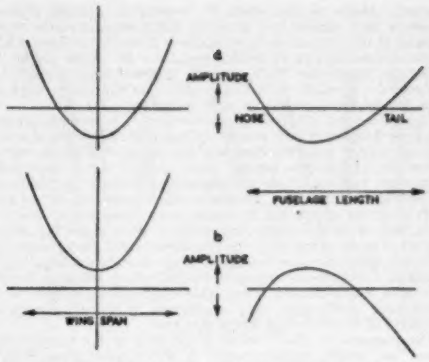


Fig. 4. Combined fuselage and wing resonance-modes.

arose with normal modes of the type shown in Fig. 4 was that the aerodynamic forces on the tailplane, during oscillations in flight, would be affected by the wing motion.

The problems discussed in this section and the next were those that arose when the pilot was given some servo assistance to overcome the aerodynamic hinge moments on the control surface. This assistance might take the form of either a spring or servo tab, or a mechanical power unit in the circuit. The flutter problem was so complicated by these devices that only one or two aspects of it could be discussed in the paper.

Tab flutter was usually described in terms of a graph of critical flutter speed against tab mass-balance (or c.g. position), such as that shown in Fig. 5. The curve on the left of Fig. 5 was analogous to that of, say, wing-aileron flutter, and flutter was eliminated by sufficient mass-balance. But for balance weights in excess of about static, another flutter branch existed. The two types of flutter were different; flutter in the left-hand branch was confined chiefly to the aileron and tab ("binary flutter"), whereas in the right-hand branch wing motion also was important ("ternary flutter"). For a very heavy tab, or for a tab with a bad frequency ratio, the two curves could join up and flutter could not be eliminated by any amount of tab balance weight. Over-mass-balance of the aileron tended to separate the branches. It was well known that a large tab inertia tended to promote flutter, particularly of the binary type involving control surface and tab.

It followed, in the same way as for the control surface, that an increase in tab inertia would have an effect similar to a decrease in t_y $(-c_3)$, and conversely. It was, therefore, to be expected that aerodynamic balance on the tab could have a strong worsening effect on the flutter. This had not yet been proved in practice by wind-tunnel tests or in flight, but good circumstantial evidence for its truth existed. Aerodynamic balance of the tab could also have a bad effect on the aileron-tab damping determinant, which again tended to promote flutter. In practice, however, it was usual for the main control surface to be designed with at least as much aerodynamic balance as the tab. This, which implied reduced $-hs$ $(-b_2)$, behaved in a similar way to an increase in aileron inertia, and had a favourable effect on tab flutter, usually sufficient to counterbalance the bad effect to be expected from the tab forward balance.

Most recent flutter incidents had been caused by spring tabs. Probably the reason for most of these incidents had been a failure to meet one of the frequency requirements adequately, and a persistent offender had been the tab mounted on one side of an elevator with a stiff interconnection between the halves of the elevator; it was better to have a spring tab on each half of the elevator and to do away with the stiff interconnection. This type of flutter was usually

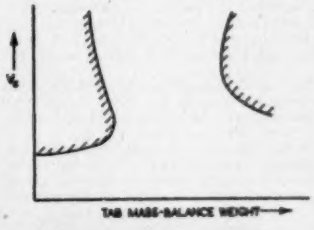


Fig. 5. Variation of critical flutter speed with tab mass-balance weight.

the binary type (see Fig. 5) but it was the ternary branch about which least was known. In particular the effect of the main surface mode on the flutter curve had not been closely investigated, but it was known to be of considerable importance, since in certain mild instances of this type of flutter a change in the wing mass distribution had stopped the flutter. Some general investigations were now being made at the Royal Aircraft Establishment.

Aerodynamic servo tabs were a form of spring tab, with no mechanical connection from the pilot to the control surface and usually with a low follow-up ratio (possibly zero). This was a big advantage as it meant that the frequency requirements were easy to satisfy. A servo tab would normally have considerable forward balance, but so would its control surface, and the combination should be satisfactory.

Powered flying controls introduced into the flutter problem an extra degree of freedom which was capable of putting energy into the motion. In analysis it was convenient to represent the extra degree of freedom by a complex circuit stiffness $(I_1+iI_2$ say), and then to solve the flutter equations in terms of I_1 and I_2. If the actual relation between I_1 and I_2 for the circuit could be determined experimentally, the flutter problem was completely solved. There were experimental difficulties in the way of measuring the required impedance, which would in general depend on the frequency, and these difficulties arose chiefly from the non-linearity of the system. Nevertheless, this seemed to be the only way to make a complete flutter check of a powered flying control that was built and ready for flight.

It was theoretically possible to do away with mass-balance on a powered flying control with no feed-back. In practice, however, not many aircraft were being designed in this way, and the only one flying in Great Britain was the Bristol Brabazon Mk 1 which carried no mass-balance on the elevator or rudder. For controls which were not mass-balanced there was no reason to change the requirement that the backlash should not exceed $\pm\frac{1}{10}$ deg, in addition to the circuit's providing adequate impedance. For powered controls which were mass-balanced, it had become current practice to give flight clearance, provided that the main resonance tests

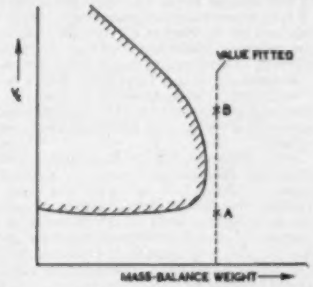


Fig. 6. Flutter curve which extends too close to amount of mass-balance fitted.

showed the mass-balance to be efficient, and provided that the unit was stable on the ground. That was to say, if the complete control (including power unit) was stable at zero air speed, and if the completely free control surface would be stable at all flight speeds, then it was assumed that the complete control would be stable at all flight speeds.

Clearance in this way was not completely watertight, even though the ground stability was checked with the unit under load or with the valve open—two conditions which were desirable, but not always easy to obtain in a ground test. Flutter could occur in this way: the complete control might be stable on the ground at its own natural frequency, but might be capable of instability if that natural frequency was changed. In flight the natural frequency would be changed, so that even if the control surface were free from flutter without the power unit, it might flutter with it. In practice, however, trouble was unlikely to occur unless the stability of the unit on the ground and of the free control in flight were both marginal.

If the control was applied to the surface through screw jacks which were solidly mounted it should be possible to avoid flutter without mass-balance. The screw jack could be designed either as a low efficiency unit which aimed at irreversibility or as a high efficiency unit of high velocity ratio, providing artificially a very high stiffness of the output circuit from the power unit. Most of the current designs which aimed at avoiding mass-balance used this latter principle in the interests of power economy. Whenever mass-balance was not fitted, the implications of a power failure had to be considered from a flutter aspect.

Almost every new aircraft experienced some sort of trouble from vibration, which might be excited either by the power plant or by aerodynamic buffeting. Often the only possibility of improvement would be to reduce the amount of the excitation, but sometimes

FLUTTER . . .

an otherwise mild vibration might be magnified by a near approach to a flutter condition, and a reduction in the magnification might give a sufficient improvement. An aircraft might, for example, suffer from tail buffeting at the natural frequency of the fuselage in vertical bending. If the elevator was only just sufficiently mass-balanced to avoid flutter (see Fig. 6), then the overall damping of the fuselage would be very low at speeds near the critical region (AB in Fig. 6). It was likely that considerable improvement would be gained by increasing the elevator mass-balance.

While a reduction of damping was often possible in this way, it was not always easy to find in practice. First must come some indication of where the basic fault lay; this might be quite apparent, such as pronounced control surface or tab amplitude in the vibration. Then steps must be taken to try to increase the margin from flutter, and with tab systems, particularly, this might be difficult to do because of the two types of tab flutter. Modifications which might succeed included changes in tab mass-balance, tab aerodynamic balance, tab follow-up ratio and control surface natural frequencies, and the addition of trailing-edge cord to the tab; but it was often a thankless task to try out these variations in flight, one after the other, with no theoretical guidance. Where possible, ternary calculations should precede any flight changes, although flight measurements should be made as soon as possible.

An important point was that the basic data should be correctly known at the start of the work. Too often a quick cure was hoped for and one or two modifications were tried. This led further, and before long a large programme of flight work had been started which might well lead nowhere; it might even prove to have been carried out on the wrong control surface (this had happened in practice). Much of this could be avoided if accurate ground resonance test results and accurate flight measurements were available at the start of the investigation. If the vibration was felt on the control column or rudder bar, then the circuit might be having an important effect, and its characteristics should be determined. It might have a large effect on the pilot's impressions, besides being important in its own right.

There were two effects of compressibility. One was the steady change in derivatives with increasing Mach number in the absence of shock waves, and the other was the presence of shock waves themselves. Little was known about either. Some theoretical calculations had been made to compare the effects of high and low Mach number derivatives (linearised two-dimensional theory was used) on flutter speed, but the results were inconclusive. On the whole they showed a slight improvement with increasing Mach number. On the other hand, the two-dimensional theory might be badly out, particularly in calculating hinge moments at high Mach numbers. Certainly the variations in static hinge moment derivatives with Mach number were often quite different from two-dimensional predictions, and sometimes suggested a greater likelihood of flutter at high Mach numbers.

The presence of shock waves could lead to "compressibility flutter" or "control surface buzz," in which growing oscillations of the aileron, for example, could occur without any wing motion. There was nothing new to report in this field; thin sections, low trailing-edge angle, maximum thickness well forward and small control surface chord were all beneficial. The structural parameters were not very important in this type of flutter, but high control circuit stiffness was generally good.

This concluded Part I of the lecture. Part II, concerned with flight flutter testing, was read by Mr. Kirkby, and will be reported in next week's issue.

A "CANBERRA" RESEARCH FELLOWSHIP

THE success of the Canberra as a modern high-speed aircraft is an appropriate background to the announcement of the establishment by the English Electric Co., Ltd., of a Glasgow University research fellowship "for the study of advanced problems involved in aeronautical engineering and research."

Holders of the new fellowship—which is valued at £500 a year—will, under the supervision of Prof. W. J. Duncan, Mechan Professor of Aeronautics and Fluid Mechanics in the University, carry out investigations into problems of vibration, stability and control.

Prof. Duncan, F.R.S., M.I.Mech.E., F.R.Ae.S., has had a long and distinguished career in aeronautical engineering. It began in the A.I.D. in 1915, and from 1926 to 1934 Prof. Duncan was in the Aerodynamics Department of the N.P.L. He then became head of the Aeronautics Department of Hull University, and from 1939 to 1945 held responsible posts at the R.A.E. He was appointed Professor of Aerodynamics at the College of Aeronautics, Cranfield, in 1945, and in 1949 became Deputy Principal.

BRITISH INSTRUMENTS IN FIAT G.80

THAT the power unit and many items of equipment in the new Fiat G.80 jet trainer are of British manufacture was announced in *Flight* of December 21st, 1951, when the first photographs appeared. It is now learned from Smiths Aircraft Instruments, Ltd., that the company was intimately concerned in the planning of the instrument equipment from the drawing-board stage onwards. The result is that, with the exception of two American gyro instruments, all the flight and engine instruments are of Smiths' design and production. In addition, the Waymouth fuel-gauge system has been adopted and a large number of Smiths' instruments supplied for the automatic observer panel, the completeness and compactness of which is a source of considerable pride to the Fiat company.

Other aircraft of Fiat design, e.g. the G.46 and G.59, carry a large number of the British company's products and similarly use the fuel-gauge system. The Vampires now being built under licence in Italy likewise embody many items of the Smiths Group.

MR. P. E. GORDON-MARSHALL'S NEW POST

AS we briefly announced last week, with portrait, Mr. P. E. Gordon-Marshall has joined the head-office staff of the Bristol Aeroplane Co., Ltd., as executive assistant to Capt. K. J. G. Bartlett, director; he took up his duties at Filton House on January 1st.

Mr. Gordon-Marshall has nearly 21 years' unbroken experience of aviation. He was apprenticed to Brian Lewis and Co. at Heston in 1931, and has held a Pilot's Licence since being taught to fly in that year by G/C. Christopher Clarkson, and the late Capt. Valentine Baker, chief instructor of the Airwork Flying School. Mr. Gordon-Marshall became sales manager of Whitney Straight, Ltd., in 1936 and three years later joined the de Havilland Aircraft Co., Ltd. In November, 1939, he was put in charge of their aircraft repair factory at Witney which, under his management, rebuilt and overhauled Hurricanes, Spitfires and various types of de Havilland aircraft.

Returning to Hatfield, he accompanied the first B.S.A.A. proving flight to Buenos Aires and initiated discussions which led to large orders for Doves in Argentina. In December 1946 he was appointed a director of Airspeed, Ltd., which position he held until the company was absorbed recently by de Havillands. He negotiated the order for 20 Ambassadors for B.E.A., and last summer made a world trip by air to meet Australian, New Zealand, Canadian and other airline operators.

HISTORICAL INSTRUMENTATION

IN his *Travels in the Air* James Glaisher, the pioneer balloonist, wrote, "A third aneroid . . . read the same as the mercurial barometer throughout the high ascent to seven miles on September 5th, 1862." This tribute to the accuracy of an early instrument is quoted in a centenary history lately published by the firm who made it—Negretti and Zambra, Ltd.

Founded in 1850 by H. Negretti and J. W. Zambra, the company is still a family business, though the last Zambra retired in 1935. During the war several factories were placed at their disposal for the manufacture of aircraft instruments and diaphragm boost controls, the latter accessories also being manufactured under licence in America for the U.S.A.F.

SAFETY IN ELECTRIC WELDING

SOME ingenious new safety features are incorporated in the design of the G.E.C. holder for welding-electrodes, which embodies a simple switch in the handle whereby all exposed metal surfaces of the holder as well as the electrode itself are automatically isolated from the supply immediately the operator releases his grip.

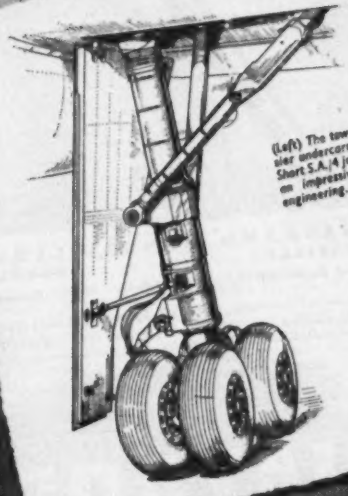
It is capable of continuous welding duty at alternating currents up to 300 amp and will accommodate electrodes of up to 4 s.w.g. The isolating contacts are housed in the handle and are operated by depressing a lightly loaded spring lever located along the body of the holder.

In order to prevent this safety feature from being deliberately put out of action by tying the lever in the "on" position, the design is such that electrodes can be inserted and withdrawn only when the switch is in the safety position.

Other advantages claimed include cool operating conditions, even when working continuously at the maximum current; long working life; simplicity of dismantling without employing special tools; and ease of dismantling should renewal of worn parts become necessary. The weight of the new holder is 24 oz.

MESSIER *Landing Gear*

FROM FLIGHT AIRCRAFT ENGINEER SEPT. 21ST 1951



(Left) The towering Messier undercarriage of the Short S.A./4 jet bomber—an impressive piece of engineering.

FROM THE AEROPLANE SEPT. 21ST 1951

Bogie-wheel undercarriages are becoming increasingly common at Farnborough, and the inward-retracting example on the Short SA.4 is a magnificent engineering achievement.

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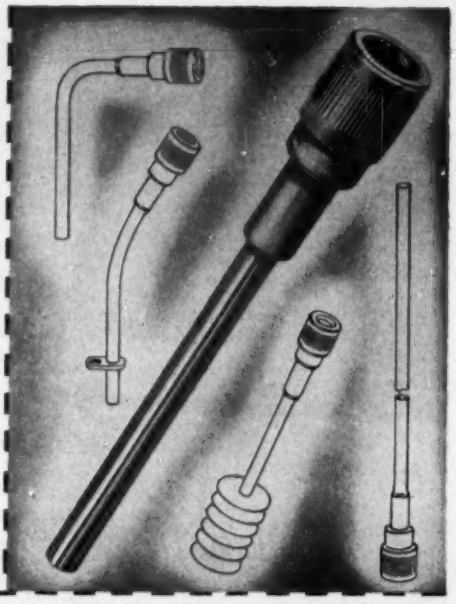

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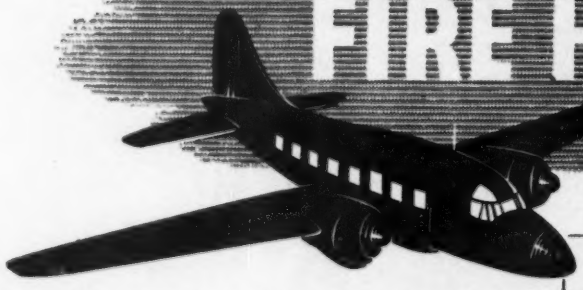

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CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Works Flying Clubs

YOUR correspondent "R.P." (December 7th) may have conveyed the impression that expenditure on works flying clubs is not justified because the number of youngsters coming forward for training is small.

The main object of forming the club named by him was to provide facilities for any employees interested in flying—irrespective of age—to gain some practical experience, and thereby give them a more comprehensive appreciation of their responsibilities. This is especially desirable for those engaged on design, and also for those directly concerned with the manufacture of aircraft.

The fact that during the summer months of 1951 over 450 hours' flying were recorded—almost the whole of which was, of necessity, achieved at week-ends—shows that support is not exactly lacking and that the firm's enterprise in forming the club is justified. It is certainly appreciated by the present members.

M. KELLY,
Hayes, Middlesex. Hon. Sec., Fairey Flying Club.

WITH reference to a letter in the issue of *Flight* dated December 7, in which a reader remarked how very few people had supported an aircraft firm's flying club, the reasons for the apparent lack of interest in flying by those in the aircraft industry are probably as follows :—

(*a*) Those technicians and draughtsmen really interested in flying and under the age of about 22 do not earn enough to afford flying rates after their living expenses have been paid. In the early stages of learning to fly it is essential that at least one hour's flying per week should be obtained and this, including solo flying, should go on for the first 50 hours. It is clear that not many juniors can afford 15s. per week for solo flying, let alone 25s. for dual; and in normal clubs the rates are twice this.

(*b*) When the same technician reaches the age of 25 and is receiving, if lucky, the A.E.S.D. rate, he should be in a position to afford the flying rates, but at this age he most probably is married. As a consequence, all thought of learning to fly has to be further postponed until he is reaching an executive stage.

(*c*) On reaching the executive stage, at 35-40 or so (he is by now too old for the R.A.F.), he finds that executives do not as a rule fly, because long ago they "realized that aircraft were too dangerous" and did everything possible to keep one foot on the ground. As the new executive is by now thoroughly discouraged, the flying club has had it.

The latter belief is borne out by the writer's experience of a large aircraft firm in which, to his knowledge, there was only one power-pilot technician who did regular flying (his age was about 24).

The question of design executives flying was taken up in *Flight* in 1945 and produced several letters in support. The writer is of the opinion that juniors will only fly in large numbers if the executives set an example.

Pinner, Middlesex. W. B. HOLROYD.

Airline Pilot Training

I AM sure there must be many people who would consider taking up flying again after a complete breakaway from it of several years. Having lost touch, however, it is extremely difficult to know where to start. Is there no scheme whereby ex-pilots with particularly valuable transport flying experience, with a thousand-odd hours behind them, and an immaculate flying record, could be signed on with a firm which would help them through the necessary examinations? It is difficult for the pilot of 30 to take the necessary courses without knowing at the end that a job is awaiting him. I am just 31, for example, with 1,000 hours all on twins and multies and all on transatlantic flying as captain and co-pilot.

Surely, the necessary instruction could be offered to advantage while acting as supernumerary crew, or something after that line, to enable airlines to acquire additional crews with the advantage of that little additional experience of age which might be used to advantage. In other words, is there any scheme with any firm which offers help in this way? If so, I feel that an article dealing with the subject would be most helpful to many readers, and might arouse the interest of certain firms who may have been short of suitable crews.

Canterbury. PITOT.

[We wonder whether "Pitot" has read the article "Airline Pilot Training" which appeared in *Flight* of December 21st last. It described B.E.A.'s pilot-training system, which appears to fulfil his requirements.—ED.]

The 1910 Coanda biplane referred to in the letter below.

The 1910 Coanda "Turbine"

I WAS browsing through my old copies of *Flight* the other evening (a delectable pastime) when I chanced across two photographs of the Coanda biplane exhibited in the Paris Salon of 1910. This machine was alleged in the captions to be "turbine driven" and "upon the turbine-propulsion system and without propellers." As a piston engine was in evidence behind the so-called turbine assembly, I presume that "ducted fan" would have been a more appropriate description. There was a note in the Salon report that a much greater tractive power was claimed for the turbine, with less vibration. I sought further enlightenment in subsequent issues, but none was forthcoming.

Can any reader supply any technical data concerning this system of propulsion?

Birmingham. J. BILLINGS.

[About a year after the publication of the photographs—in November, 1911—an American reader was still seeking the information now requested by Mr. Billings. He had written to the Coanda company but received no reply. A photograph of the machine is reproduced above.—ED.]

Bureaucracization?

CAN we have simpler words in aviation? For example, why not call "winterization tests" and "tropicalization tests" by the shorter and more easily understood "cold-weather tests" and "hot-weather tests"? And does not "pressurization" merely mean "pumped up"? There are many other words, dear to bureaucrats, which would be much better in simple English.

London, S.W.3. GEOFFREY DORMAN.

Visiting B-36s

I NOTE that under the heading "Inaugural Visit" on page 775 of *Flight* for December 21st, you state that the recent visit of six B-36s to Slimane represented the second transatlantic crossing by this type of aircraft.

Actually, the first visit by B-36Ds was made when the first of a formation of six arrived at Lakenheath on January 17th last (not, as you say, January 12th). By mid-day, six had arrived and each stayed for about 96 hours. All arrived back at Carswell A.F.B. on January 22nd.

The second publicized visit by B-36s took place when three arrived on the morning of June 29th from Texas. On July 1st they flew over London and thence to Paris, making a pass in the Paris Aero Show. They flew back to Lakenheath and returned to the U.S.A. on July 3rd.

The B-36 is surely the noisiest aeroplane ever, and unmistakable. Judging by an occasional repetition of this din over Eastern England, other visits have also occasionally been made.

Whilst I have only once heard a lone B-36 at night, several people have heard or seen them over at unannounced times.

Cambridge. M. J. F. BOWYER.

Short Brothers

WITH reference to the photograph and notice of appointment concerning Mr. J. W. Carpenter, published on page 770 of *Flight* for December 21st, 1951, may I respectfully point out that Short Bros. had *several* factories in the Swindon area, managed by the much-respected Mr. P. Shepherd, with Mr. J. W. Carpenter as manager at one of these factories?

I am sure that all of the 5,000 employees of Short Bros. (R. and B.), Ltd., Swindon Division, will remember the excellent leadership of Mr. P. Shepherd (divisional manager).

Snodland, Kent. C. J. BLACKMAN.

Commercial Aviation Commentary

By HENRY MORRIS

Series II: No. 3

LISTENING to the recent Lords debate on civil aviation, one could not but wonder what was the object of the whole exercise. Perhaps, behind the rather laboured but ambiguous statements of the Government speakers, the weighty and obvious "catch questions" of former Socialist Ministers, and the insistent speeches by a few Peers with axes to grind (or past actions to justify) was the obscure thrust-and-parry of Parliamentary manœuvring; but only a skilled politician, and certainly not a layman, could assess which side, if any, gained the most points.

What did it all boil down to? The Government committed itself to nothing new. And, examined in *Hansard*, its few positive statements seem even more ambiguous. The essence of the Government's case was, "We have as yet no detailed policy. We favour the combination of public and private enterprise in the national and best interests of British civil aviation. Some of us feel that private operators can play a more important part in the development of civil aviation—but we are not quite sure how. We will not undermine the existing international networks of B.O.A.C. and B.E.A. We fully appreciate the recent improvements in the financial position of the Corporations, but this must be considered in perspective with the state of the industry as a whole. We will carefully consider the future of the M.C.A. and not do anything impetuous."

From this neither the Corporations nor the private operators could have gained much consolation, though both sides could feel that they were at least reprieved and would have more time in which to brief their counsel before appearing in court again! The Corporations now know that the Government does not intend to decimate them, while the private operators know that the Government will endeavour to give them a larger, or at least a more definite and secure, place in the air-transport pattern.

But could anything more definite be expected at this stage? Air transport can no longer be regarded as a minor and annoying problem detached from (and insignificant in comparison with) other national and international problems. It is now of major strategical importance; it can have a profound effect on the aircraft manufacturing industry and thus the dollar export trade; it can give a tremendous impetus to another great dollar-earning industry, the tourist trade; and it is daily becoming an increasingly vital link in the political and economic development of the Colonies and Commonwealth. But did the Opposition really expect to extract any definite statement of policy from the as yet swaddled Government? The Government speakers could hardly say more—and certainly no less—than they did.

• • •

IT is an odd reflection on our present topsy-turvy state that the Opposition speakers appeared to be presenting themselves almost as the mouthpieces of the Corporations.

One could almost feel the anticipatory glee with which Lord Ogmore put over his No. 1 "catch question": "When he (Lord Leathers) said that we do not want to interfere in any way with the activities of the Corporations, he means, does he not, that on one overseas route there will be one British Corporation operating and not more? I think that is essential." And how justified his anticipation when Lord Leathers replied: "My answer to that is really 'yes,' but I must make this proviso. That Corporations must be able to cope, and cope successfully, with the traffic, or some other view will have to be taken."

What could be more definite? Ah, but wait—this is not quite so good: there are loopholes. What does "overseas" mean? Perhaps Lord Leathers will say that by "overseas" he meant "to foreign countries." Perhaps he will not regard inter-Commonwealth or inter-Colonial services as "overseas." Also, much worse, he referred to *one* Corporation. Perhaps, (perish the thought!) he did not mean that to apply to a *Company*. Perhaps later he will say that he merely meant that one State Air Corporation would not be allowed on the routes of another State Corporation, such as B.E.A., operating to Cairo as well as B.O.A.C. So much for the ambiguity of Parliamentary niceties!

A real surprise was the uncompromising and unrelenting attitude of Lord Pakenham. In office he courageously adhered to his conviction that his first duty was to support, encourage and protect the Corporations; but it is hard to believe that he really thinks (as he implied in the debate) that an era of prosperity and promise has burst on the private operators. The situation of the few survivors has certainly improved, largely by reason of an unforeseen demand for air transport brought on by international tensions; but the private operators still have no more security of tenure in their operations than they had five years ago, and certainly not a tithe of the minimum security necessary to finance re-fleeting programmes.

Lord Pakenham said in the debate that "the charter companies now have a very lucrative business in ordinary charter work"; yet the late Government did not even define "charter work" and to this day the private operators do not know exactly what sort of operations they may or may not undertake, or for how long they may be allowed to continue with their existing meagre work. All they know is that they may not operate "scheduled services"—but no one will tell them exactly what that means!

• • •

AGAIN, Lord Pakenham was at pains to emphasize the very great improvements and promising results now being achieved by the Corporations. Nobody will deny these improvements and everyone is very glad to see them and hopes they will continue. But this persistent emphasis on betterment tends to make people think "Why all this propaganda? What are they trying to put over? Let's look into it a little more clearly." Conclusions after such a look might well be: "It's time these better results were achieved; they could hardly have been avoided. They surely could have been achieved much earlier; and, in any case, are they really as good as they should be? Isn't there still a great deal of lavishness which could be curtailed? And at what cost to the overall strength of British air transport have these improved results been gained?"

But withal, the debate showed sufficient statements of high purpose to justify the hope that a new and fairer era is dawning and that a policy for British air transport will be hatched out which really will put the interest of the industry and the public before party politics. Lord Leathers' determination to do this was in fact the one and only firm definite statement of Government intentions.

It is unfortunate that a discordant note was struck by Lord Pakenham, who said:—

> "With an expanding business, with the Corporations doing better all the time and the charter companies doing better all the time, it ought not to be impossible to find a means of reconciling their interests. We shall await with great interest the efforts of the noble lord to bring about the harmonization. I do not want to adopt a tone of violence, let alone of threats, but I must inform the noble lord that if he found it impossible to bring about this reconciliation and he took steps which, in our view, damaged the Corporations, we should fight him by every constitutional means, here, elsewhere and everywhere. I must put that quite plainly on record."

This statement, which is not softened at all when read in its context, can mean only that any step which in the view of the Opposition "damages" the Corporations (even if such "damage" is caused by an operation which will result in a big improvement in the health of the industry as a whole) will be opposed "here, elsewhere and everywhere." This does not sound a very hopeful or even constructive policy; but perhaps time and events will soften the threat.

CIVIL AVIATION

INAUGURATION : On the fortieth anniversary of the first flight by the Wright brothers, the first of Eastern Air Lines' new fleet of Lockheed Super-Constellations took off from Newark Airport for Miami on its inaugural scheduled service.

INDONESIAN PILOTS TRAIN HERE

AN important stage has been reached in the early development of civil aviation in Indonesia—a country which, because it comprises vast island territories in an area some 2,500 miles across from east to west, can profit tremendously from the benefit of air communications of all kinds. There are probably few people in this country who appreciate the extent of the islands—Sumatra, Java, part of Borneo, the Celebes, Moluccas, and so on—which comprised the Dutch Indies until the Republic of Indonesia was formed. In fact, their area of 735,000 square miles is more than twice that of Pakistan, for example, and the population—some 75 million—is also greater than that of Pakistan.

At least three other nations have been interested in the development of civil aviation in Indonesia—America, Holland and Britain—and all are, in effect, in competition as advisers and developers of aviation in the Republic. It is therefore a feather in the cap of this country, and of Air Service Training, Ltd., that the young men who have now been selected and officially sponsored to become the nucleus of commercial pilots for Indonesia's airlines should, after examination of the training facilities in several countries, have been sent to Hamble.

Last Wednesday, January 9th, the first contingent of 18 young Indonesian men was due to arrive at Southampton to begin its 2½-year training course with A.S.T. Others are to follow at intervals, and a total of about 75 are expected under present plans. All will have flown solo and have been graded before travelling to this country, and they will also be able to speak English. Those who are successful will return as fully qualified (though, of course, inexperienced) commercial pilots with something over 300 hours on types up to the Dakota.

This first party of young pilots received a big send-off from Jakarta (previously Batavia), the Indonesian capital in the island of Java, and plans had been made for them to receive a civic welcome on arrival at Southampton. In charge of the party and travelling with them is Mr. (and Mrs.) Grandjer, an official of the Indonesian Ministry of Civil Aviation. It is understood that he will also be looking round for aircraft, both for training and of the feeder-liner type, during his visit to this country. Already there have been preliminary discussions regarding the possible purchase of a sizeable batch of D.H. Herons, and it is believed that the Chipmunk is another aircraft considered to be very suitable for Indonesian requirements in the training field.

Although no definite announcement has been made it is understood that the intention is to form a training school in Indonesia towards the end of the year, and that not only the aircraft for it but management and instructors may be sought in this country. Incidentally, the Hawker Siddeley Group (and therefore A.S.T.) agents in Jakarta are Dunlop and Kolff. Next week we expect to give some details of the training which Indonesian student pilots will undergo with A.S.T., and to give their views on the future of civil aviation in Indonesia.

At present, services within the country itself are operated by Garuda Indonesian Airways, a jointly owned airline which until recently was a subsidiary of K.L.M. Ownership is now shared with the Indonesian Government and local personnel are being trained to take over duties formerly carried out by those of the Dutch company.

THE DOUGLAS DC-7 ORDERED

THE biggest domestic operators in the United States, American Airlines, have announced their intention of ordering 25 of a new type of Douglas transport to be known as the DC-7. The machine will be an enlarged and higher-powered version of the DC-6B, will be fitted with four Wright Turbo-Compound engines of 3,250 h.p. each, and will cruise in the region of 360 m.p.h. Initial delivery is mentioned as being late 1953, and it is intended that the first scheduled services with the DC-7 will begin on January 1st, 1954.

The prospect of a 360 m.p.h. cruising speed means that the DC-7 will actually reach well into the turboprop-transport speed-range, with a fuel consumption which will be considerably better than that of aircraft fitted with full-turboprop or even piston-engine power plants of comparable output. The specific consumption of the Wright compounded engine is as low as 0.39 lb b.h.p. Other improvements in the DC-7 are a 16,800-lb increase in permitted gross weight over the DC-6B and a slightly lengthened fuselage which will accommodate 60/66 first-class passengers or 95 passengers in a "coach" version. American Airlines will have to pay almost $1,600,000 each for these machines.

As the amortization period of A.A.'s new fleet can be estimated at something in the region of six to eight years, it appears that the company is yet another of the diehard American operators which are determined to make money out of exploiting the lower-speed, high-capacity mode of travel to the full rather than pin hopes on high-speed jet transports at their present (or presently contemplated) stage of development.

It is assumed that, should a suitable turboprop become available, the DC-7s would eventually be converted to this type of power unit.

In this connection, incidentally, it is reported that the U.S. Navy has now confirmed its plans to build two prototype Super-Constellations (R 7O-12 in naval nomenclature) fitted with four Pratt and Whitney T-34 turboprops, each developing over 6,000 h.p. It is expected that these machines will

CAPACITY LOAD : Five-abreast seating in the first of Eastern's Super-Cannies does not seem to provide an uncomfortably cramped layout. A full complement of 88 passengers was carried on the first service; the take-off is illustrated in the heading picture.

CIVIL AVIATION . . .

cruise at about 394 m.p.h. Thus, American airlines are in the fortunate position of having much of their transport prototype operating experience paid for by a military service—a fact which will, no doubt, be reflected in the final operating costs which they will experience when similar equipment is acquired for commercial use.

TURKISH TERMINAL

DESPITE many difficulties, not the least of which has been the severe weather conditions experienced, work on the extension and rebuilding of Istanbul (Yesilkoy) Airport has been progressing steadily for more than two years, and it is now reported that the site will be opened in its new guise next May. In addition to the Turkish State Airline no fewer than 13 foreign operators already use this airport regularly. When it is re-opened it will, in fact, be able to accommodate the largest commercial aircraft now in use anywhere in the world. An important aspect of the new installations will be a shortened asphalt highway, from the airport to the city of Istanbul, which will allow a considerable saving of time and a more comfortable road journey for passengers.

It is reported that Pan-American World Airways have now decided to transfer their Middle East headquarters from Beirut to Istanbul, which is already an important terminal for B.E.A.

A YEAR'S TRAFFIC

ALTHOUGH the end of the calender year does not necessarily constitute the termination of the statistical year for most airlines several companies do, in fact, issue a review of their traffic activities during the preceding twelve months. This often serves as an indication of what can be expected in the way of results for the financial year, which in some cases does not end until another three months have elapsed. Both of the British Corporations are among the companies which have reported encouraging results for the year ended December 31st, 1951. In this period B.O.A.C. flew a total of over 762,000,000 passenger-miles, as compared with a figure of some 525,000,000 for the previous year. The total of passengers carried (237,400) was 31 per cent better than that achieved in 1950. The amount of cargo lifted also represented a 12 per cent improvement on figures for the year before. One of B.O.A.C.'s most notable increases was that seen on the North Atlantic route, on which during the year a peak frequency of 18 services a week in each direction was reached. The number of crossings made last year amounted to 1,446.

B.E.A. also had a good year from the statistical viewpoint and for the first time in the Corporation's history more than 1,000,000 passengers were carried in one year. The final figure is expected to show a 25 per cent increase over 1950's result.

American operators had an equally good year, and for the second time in succession P.A.W.A. carried appreciably more than 1,000,000 passengers. In Canada, T.C.A. experienced increases of 18 and 15 per cent for the totals respectively of passengers and cargo transported. It has been estimated by Sir William Hildred, the Director-General of I.A.T.A., that a total of about 39,000,000 people travelled on the world's airlines last year. It is considered that there will be a further sharp rise in the traffic for 1952, a year which will be characterized by two historic innovations. In the first place, the public will have its first chance to fly in turbine-powered aircraft. Secondly, despite rising costs everywhere else, the airline industry has undertaken a bold experiment in introducing cheap tourist-class services which, in the case of the North Atlantic route, will be offered for as little as 5d per mile. In 1950, the total number of people crossing the Atlantic was 300,000. It is now estimated that at least 500,000 will make the crossing this year.

As far as safety is concerned the overall result for the world's airlines has not yet been published, but in 1950 there were only 2.46 fatalities per 100,000,000 passenger-miles, as compared with rates of 2.87 and 3.28 in 1949 and 1948 respectively. It has been estimated that U.S. international airlines stayed well below the international rate in 1951, with approximately 1.2 fatalities per 100,000,000 passenger-miles.

HUNTING'S NEW SUBSIDIARY

HUNTING AEROSURVEYS, LTD., have for some time been engaged on survey work in Pakistan and it was considered recently that scope now exists for a survey company to be based in Pakistan itself. Accordingly a new firm, Hunting Aerosurveys (Pakistan), Ltd., has been formed in Karachi in conjunction with Greaves, Cotton and Co. (Pakistan), Ltd. It is not generally known, perhaps, that the Hunting Group have built up the largest operating organization in the world for the application of aerial methods to cartographic survey. Associated companies have been formed in Canada, Australia, New Zealand, South America, South, Central and East Africa in addition to the headquarters in London, which is actually responsible for covering a large proportion of Europe, the Mediterranean, Middle and Far East.

BREVITIES

THE Spanish State-owned airline, Iberia, has been granted permission by the Allied High Commission to fly the Frankfurt-Barcelona route at an initial frequency of one flight per week in both directions. The Spanish company will use DC-4s on these services. With this latest addition, the number of airlines flying into Frankfurt is raised to sixteen.

* * *

In order to absorb the large increase in traffic between the United States and the Orient which is expected to follow the Japanese Peace Treaty, United Airlines have now opened a Tokyo sales office. Domestic services within Japan—flown by a locally organized company using Martin 2-0-2s and DC-4s chartered from abroad—have been operating since November 1st.

* * *

Airwork, Ltd., which claims to be Europe's largest non-scheduled operator, has once again been successful in securing a renewal of its contract with the Sudan Government to run a "leave" service between London and the Sudan. The company has been responsible for this operation since its inauguration in 1946. As in the past, Vikings will be used, but at peak seasons they will be augumented when necessary by the Hermes aircraft which Airwork has recently acquired. The operation has grown annually until, in 1951, a total of 150 flights was made.

* * *

At a recent meeting of members of the Scottish Advisory Council and the Scottish Aerodromes Board, the Minister of Transport and Civil Aviation, Mr. J. S. Maclay, reiterated the need for further development of Prestwick Airport. It was his earnest desire, he said, to improve the existing facilities without delay. Several proposals for immediate action on the expansion of facilities at Prestwick were put forward for discussion. It is understood that these matters will probably be finalized before the end of January.

* * *

Financed under the Marshall Plan, an airfield has been constructed on the Greek island of Mytilene, near the coast of Turkey. Last week the Greek National Airline began regular operations between this point and Athens, turning what had been previously an 18-hour sea voyage into a one-hour flight.

* * *

The M.C.A. airfield at Lympne had recently to be closed to all aircraft of over 8,000 lb a.u.w. because of damage to the grass runway surfaces. The most important operators of heavy aircraft here are, of course, Silver City Airways; largely because of their movements, freigh ffigures for Lympne during the summer months are four times as much as at L.A.P. Although metalled runways and modern aids are badly needed, it is understood that so far no plans have been made to provide them.

* * *

Next month Norway will acquire its first helicopter, a Hiller 360. Fitted with two stretchers, the machine will be used chiefly for ambulance flights but will also be employed for forestry and cable inspection and for spraying. Thorsten Thelle of the Norwegian Helicopter Service, states that it is intended to acquire several more helicopters. A Norwegian whaling company has ordered a helicopter for use during next year's season in the Antarctic.

* * *

One of the longest charter flights ever undertaken by a British independent operator ended last week when a York of Eagle Aviation, Ltd., returned to the United Kingdom after a journey of 30,750 miles. The aircraft left London on December 6th for Iwakuni, in Japan, carrying Christmas mail for troops in the Far East. It then picked up 13 Phillipine seamen at Hong Kong and flew across the South Atlantic to Natal, Rio de Janeiro and Porto Alegre before returning to this country.

* * *

Local authorities in areas adjoining London Airport are being invited by Feltham (Middlesex) Council to participate in setting up a joint committee to discuss questions which arise in connection with the airport, and which affect either the district or local residents. The proposed committee would then be able to make direct approaches to the M.C.A. or to other Government departments concerned. It is not intended that this should supersede the present London Airport Joint Consultative Committee, to which the local authorities have already appointed representatives.

A party of Sudanese Government officials and Commercial Representatives at Blackbushe Aerodrome

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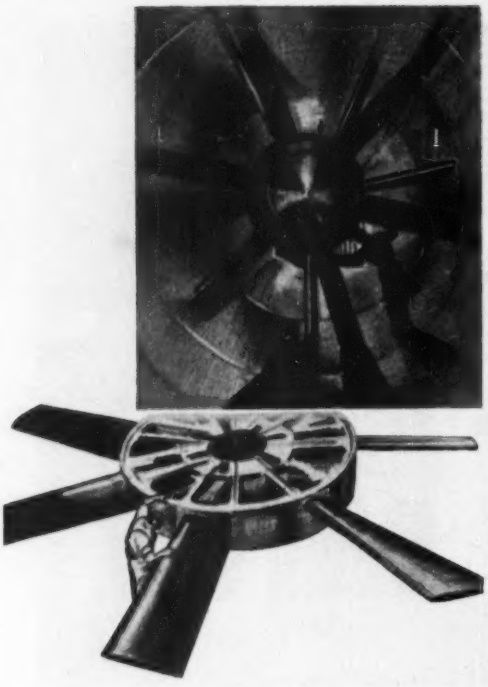

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CIVIL AVIATION . . .

The number of air transport movements recorded at U.K. airports in November was 11,142, 5.2 per cent more than in the corresponding month of the previous year. The total of passengers handled showed an increase of 39 per cent over that for November, 1950, while the amount of freight on- and off-loaded (3,169 tons) represented an increase of 13 per cent.

* * *

December 27th marked the twenty-fifth anniversary of an event which represented an important stage in the development of British air routes. On that day, in 1926, the then Secretary of State, Sir Samuel Hoare, flew by Imperial Airways in a D.H.66 from London to India to inaugurate the first section—then between Cairo and Karachi—of what was later to become the Imperial Air Route to Australia. Sir Samuel's party arrived in India early in January.

* * *

Following the recent refusal by the C.A.B. to approve an application for coast-to-coast "air-coach" fares, United Air Lines have now submitted an amended proposal containing adjusted rates. The new fare structure, however, is still the lowest ever offered by any of the American scheduled transcontinental carriers.

* * *

In 1951 Aer Lingus experienced its busiest year on record. Almost 270,000 passengers used the company's services—21 per cent more than in the previous year; over 123,000 of them travelled between London and Dublin. Other routes across the Irish Sea showed increases ranging up to 36 per cent, and Jersey traffic, also, was almost doubled. More than 3,800 tons of all types of cargo were transported—46 per cent more than in 1950—while the quantity of mail carried was over five and a half times last year's total.

* * *

The amount of freight handled by Australian National Airways has continued to rise sharply and at present is averaging over 600 tons a week. To meet this demand A.N.A.'s freight department at Essendon now occupies two complete hangars with a floor space of 18,000 sq ft. The company is rapidly becoming one of the world's largest freight-carriers and specializes particularly in the carriage of bulky loads.

* * *

After ten days of conference, the attempts by representatives of Mexico and the United States to establish a bilateral air agreement have once again come to nothing. The deadlock was reached over the fact that the Mexican Government does not wish to allow new airlines to operate into Mexico, while the Americans are similarly unwilling to allow any expansion of Mexican services over and above the existing route between Mexico City and Los Angeles.

* * *

Marconi "walkie-talkie" sets, weighing less than 15 lb each, are now being used extensively by aircraft engineers and traffic staffs at both London and Northolt airports. At L.A.P. they are particularly useful for maintaining instantaneous contact between aircraft and maintenance supervisors who may be up to three and a half miles away from their control point if located in the farthest dispersal. The Marconi unit is completely self-contained, is approximately the size of a shoe box, and is worn strapped on the back.

CLUB AND GLIDING NEWS

HAVING braved the trials and tribulations of another difficult year, the directors of most British flying clubs are now busily engaged in totting up their totals—for the most part congratulating themselves on the number of hours flown and trying not to feel too badly about the crimson hue of the financial balance as indicated in the right-hand margin. In general, enthusiasm has been maintained at a high level during the year, proof of which fact is contained in some of the following 1951 results for clubs from whom we have been able to obtain information :—

	Hours flown	Licences issued	No. of flying members
Herts and Essex Aero Club	3,606	33	250
Wiltshire Flying Club ...	2,570	37	156
Redhill Flying Club ...	2,123	29	194
London Aeroplane Club ...	2,060	25	218
Southend Flying School ...	1,850	11	80
Fair Oaks Aero Club ...	1,616	25	245
Denham Flying Club ...	1,500	8	160
West London Aero Club ...	1,265	20	250
Cheltenham Aero Club ...	860	9	100
Cambridge Aero Club ...	595	19	210

As far as can be estimated from the current British *Register of Civil Aircraft*, about 550 privately- or club-owned machines are now in full flying trim in this country, a figure which compares sadly with a total of 85,000 machines which a recent F.A.I. survey indicates are probably available for flying in the United States. In that country, incidentally, the number of private licences issued annually (that is to say, excluding renewals of existing licences) is said to be over 20,000. Several other nations also—among them France, Brazil and Cuba—are thought to enjoy considerably more sporting aviation activity than does Great Britain.

NEWS from Scotland indicates that the 25-year-old Scottish Flying Club which, in 1927, pioneered the development of Renfrew Airport, and which has continued to exist only under extreme difficulties since the Air Ministry requisitioned its base and aircraft in 1939, is now hoping that the recent change of Government may soon result in its return to Renfrew.

Last week a deputation of club officials was received by the Minister of Transport and Civil Aviation, Mr. J. S. Maclay, who has been taking the opportunity afforded by the Parliamentary recess to spend some time at his home in Kilmacolm and also to visit Scottish Aviation authorities. Mr. Maclay recently motored over to Renfrew where he was joined by the M.C.A.'s permanent secretary, Sir Arnold Overton, to carry out a tour of inspection of Renfrew Airport. Later, at the St. Enoch Hotel in Glasgow the Minister met members of the Scottish Aerodromes Board and the Scottish Advisory Council. It is alleged by these two organizations that Mr. Maclay's predecessors "studiously disregarded" their advice.

The Minister is understood to be sympathetic towards the needs of the Scottish Flying Club, and its members—now temporarily based at Scone—are hoping that the day when they can resume their activities at Renfrew will not be far distant.

FOLLOWING the success of last year's periodical film-shows given at Londonderry House for Royal Aero Club members and their friends, a further programme has been arranged this winter and has already proved a big attraction—so much so that when the classic Howard Hughes picture *Hell's Angels* was screened on December 18th a number of people who turned up late were crowded out; a ban on late-comers is now to be imposed. All programmes begin at 6.15 p.m.

In connection with the talk, *Campaigning in Korea*, which is to be given by Mr. William Courtney, O.B.E., M.M., on Tuesday next, January 15th, a series of film-shows is to be given on succeeding dates, each consisting of pictures taken in the war area by Mr. Courtney. Details are: January 28th, *Campaigning in Korea* (with the U.S. ground and air forces in the Naktung River perimeter during the summer of 1950); February 5th, *British Brigades in Korea* (with the 27th and 29th Brigades in the winter of 1951, showing the advance to Han River and Seoul); February 21st, *H.M.S. "Theseus" in Korean Waters*. On February 26th the audience will see *Malaya March*, which Mr. Courtney made in Malaya, showing jungle marches and R.A.F. and R.A.A.F. supply-dropping in the war against the bandits.

The films contain a large number of flying sequences, including air pictures of B.29 missions in which the lecturer was able to take part.

These pictures are additional to the film evenings already arranged, the next two of which are on February 12th, when three pictures will be shown, *Vickers Viscount*, *A Visit to Hong Kong and Tokyo* (Philippine Air Lines) and *Air Parade*; and March 13th, when *Twelve o'clock High* will be screened.

It should be noted that admission to these shows is confined to R.Ae.C. members, associate members and their guests.

THE British Gliding Association states that scarves and squares have been prepared for members. Made from rayon and silk, the scarves are in navy blue with gold diagonal stripes and small silver sailplanes. Scarves (48in x 10in) cost £1 3s and squares (30in x 30in) £1 15s. Applications for these items should be addressed to the secretary of the B.G.A. at Londonderry House, Park Lane, London, W.1.

AGRICULTURIST from AMERICA

Piper PA-18-A for Spraying and Dusting

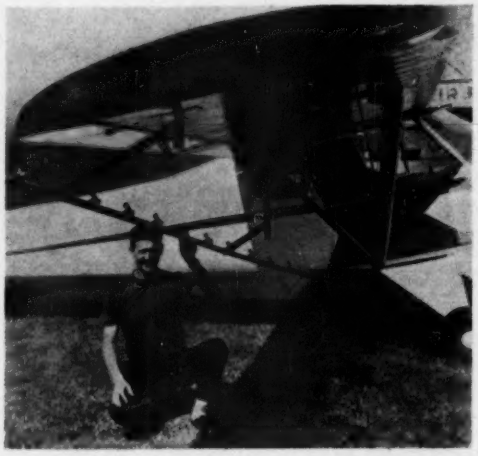
DURING the past three years, the Piper Aircraft Corporation has been working with the Ohio State Aviation Board, the Delta Experiment Station and other organizations in order to evolve the best specification for an agricultural aircraft. The outcome of this work is the recently announced Piper PA-18-A combined duster, sprayer and general utility aircraft.

Developed from the Super Cub, the PA-18-A is designed specifically for farm use, the Piper Corporation also being responsible for the dispersal equipment. Pilot safety—of special importance in this low-altitude agricultural work—has been improved by the fitting of a heavy-duty safety belt and of shoulder harness, while wire cutters have been added to the landing gear. The main fuselage structure has also been modified in order to accommodate the large insecticide tank. This tank holds 110 gallons of liquid or 18 cu ft of dust and is easily removable.

For spraying, two streamlined booms, each carrying 12 spray nozzles, can be fitted under the wings as shown in the accompanying photograph. Together, they put down a swath 50ft wide, the coverage being variable between a half-gallon and five gallons per acre by adjustment of the nozzle orifice size and the delivery pressure from the slipstream-driven gear pump.

One and a half man-hours suffice to convert the aircraft to dusting, for which work the same tank is employed. Two agitators driven by shafting from a windmill assist the dust to fall into twin venturi-type distributors.

In either condition, it is claimed, the aircraft can effectively treat up to 220 acres in 45 minutes with one load of up to one-half ton of insecticide. Super Cubs of earlier types are said to have sprayed over 1,000 acres of cotton or wheat per day.



. The Spray-bars swing back if they hit an obstruction

That our own industry is not backward in the development of agricultural aircraft was demonstrated by an account in *Flight* of March 30th, 1951, of the spraying of 17,000 acres of the Anglo-Egyptian Sudan by three Agricultural Auster Aiglets owned by Aerial Spraying Contractors, Ltd.

Air Year Reviewed (continued from page 31) . . .

May.—In Korea, on the 9th, over 300 U.N. bombers and fighters took part in the biggest raid, that on a Communist air base. A fortnight later, 500 aircraft of the N.A.T.O. Powers participated in Exercise Ombrelle.

At home, on the 3rd, the Festival of Britain opened, with a somewhat disappointing display of aircraft in the South Bank transport pavilion. There were flying events throughout the month, including the R.Ae.S. Garden Party at White Waltham and air displays at Plymouth, Shoreham, Hucknall (attended by 75,000 people), Derby (where F/L. J. Finlay won the Harben Trophy Race), and Wolverhampton (where Fred Dunkerley, in a Miles Mercury, won the Goodyear Trophy at 161 m.p.h.).

The Vickers 660, four-jet bomber, later to be announced as the Valiant, was airborne for the first time on May 18th, in the hands of Capt. J. Summers.

On that day we announced that Vickers-Armstrongs, with the Swift (as yet unpublicised) had secured the first contract for swept-wing fighters for the R.A.F. The D.H. Sprite rocket-motor had its first flight test (in a Comet) on the 7th.

Lincoln Ellsworth, famous polar flier, died in New York at the age of 71. On May 10th, Maj. F. B. Halford became president, for 1951-52, of the R.Ae.S.

British air services were stepped up for Festival traffic: B.O.A.C.'s "Monarch" Stratocruiser service, inaugurated on March 1st with five flights a week from New York to London, was increased to a daily frequency. Sir Miles Thomas, the Corporation's chairman, returned from a tour of the Americas, expressing himself "both encouraged and chastened" about B.O.A.C.'s progress there (its route down the west coast of South America had just been withdrawn). B.E.A. discontinued their London-Prague services on May 18th, largely owing to the obstructive tactics of the Czech authorities. A French operator's order for two Series I Comets was announced. Lord Pakenham, Minister of Civil Aviation, was appointed First Lord of the Admiralty.

The ban on gliding by Germans of the Federal Republic was lifted. In England, F/L. W. A. Bedford established a new British gliding record of 250 miles to a declared destination.

On May 26th, in dull weather which nevertheless failed to prevent the fly-past, the King's Colour was presented to the R.A.F. in Hyde Park, Princess Elizabeth deputizing for the King.

At mid-month there occurred the tenth anniversary of the first flight of the Gloster E.28/39, and this we celebrated by publication of a Gas Turbine Number on May 11th. Other special features which we published during May included a history (by John Yoxall) of No. 7 Squadron, a design-analysis of the Percival P.56, adopted as the R.A.F.'s new basic trainer. and the first of a series by K. W. Gatland on guided-missile evolution.

The Editor flew our Gemini to Holland in order to make an air test of the new Fokker S.13 twin-engined trainer.

On the 29th, H.M.S. *Theseus* returned to England after six months in Korean waters, during which her aircraft flew 3,446 sorties. On the 29th-30th, the U.S. pilot Capt. Charles Blair flew his Mustang *Excalibur III* over the North Pole from Norway to Alaska, 3,375 miles at 321.4 m.p.h., then almost immediately on to New York, another 3,400 miles.

British aircraft exports for May were valued at nearly £4 million—almost £900,000 up on the monthly average for 1950.

June.—Outstanding event of the month was the Paris Show; it opened on the 15th, to conclude on July 1st with an international flying display at Le Bourget that attracted nearly a quarter of a million spectators. At the Show, the Rolls-Royce Avon made its first public appearance.

In England, the H.P. 88 (destined to be lost, with its pilot, D. J. P. Broomfield, two months later) made its first flight on June 21st. Westlands demonstrated the S-55 helicopter, similar to one which had flown-out over 100 casualties during a short period of experimental operation in Korea. In America, the big new Class N Goodyear airship made its maiden flight on the 18th, and two days later, in Canada, the Orenda-powered CF-100 flew.

Lord Ogmore was appointed Minister of Civil Aviation on June 1st. On this day B.O.A.C. reintroduced their New York to Bermuda service, suspended since March 1950. B.E.A. were forced, by aircraft shortage, to limit or suspend services on six routes. On the 5th, I.C.A.O.'s Fifth Assembly opened in Montreal; Spain was elected to a vacancy on the Council. A Hermes V (four Theseus turboprops) flew from London to Paris in 46 min. On June 1st, B.E.A. inaugurated their London-Birmingham helicopter service with Westland-Sikorsky S.51s. On June 7th, the N.W. Chain of the Decca Navigator system was inaugurated.

P. A. Wills, on June 3rd, achieved a British out-and-home gliding record of 160 miles. During the month, air displays were held at Rearsby, Fair Oaks, R.N. Air Station Bramcote, Swansea, and elsewhere.

Prof. A. A. Hall was appointed to succeed the late Mr. W. G. A. Perring as director of the R.A.E.

A major disappointment was the abandonment, through bad weather on the 23rd, of the Festival of Britain National Air Races.

Notable articles in *Flight* during the month included an account, by a member of the staff, of a tour of Scandinavia's air routes. Handling impressions of the Short Sealand were also given.

On the 29th this journal sustained a grievous loss by the death of its Editorial Director, Mr. G. Geoffrey Smith.

(To be concluded next week)

SERVICE AVIATION

Royal Air Force and Naval Aviation News

Meteors Get Two Migs

IN a battle which developed during a fighter sweep north of Pyongyang, Korea, twelve Meteors of No. 77 Squadron, R.A.A.F., were attacked by a formation of over 50 Migs. A dogfight ensued in which two Migs were shot down, the first by F/O. Bruce Gogerly and the second as a result of a co-operative effort by several pilots. One Meteor was hit but was able to return to base.

Silver Fox Squadron for Britain

CANADIAN AIR FORCE headquarters have announced that the next unit to join the R.C.A.F. fighter wing at North Luffenham, in February, will be No. 441 (Silver Fox) Squadron. It will fly Canadian-built Sabres and be commanded by S/L. A. MacKenzie, D.F.C.

No. 439 Squadron will follow later and, with No. 410 (Cougar) Squadron, already based at North Luffenham, will complete the complement of the wing. S/L. C. Bricker, D.F.C., is the commanding officer of No. 439 Squadron.

New Year Further Awards

THE following names are a continuation of the list of R.A.F. New Year Honours and Awards, the first part of which we published last week :—

AIR FORCE MEDAL.

Flight Sergeants J. Bush; W. C. Jenkins (now Master Signaller); J. Moore, D.F.M.; F. C. B. Penny; C. T. Rylatt; M. H. Sloan.

Sergeants E. E. Barff; E. J. Darling; C. H. Evans; A. M. Ford; A. Forman; F. C. Hicks; H. L. C. Kennedy; A. Ramsden; A. J. Spence.

BRITISH EMPIRE MEDAL (Military Division).

Flight Sergeants V. A. C. Charrison; F. L. Clarke; W. Cottam; H. W. Cunnington; R. G. Ferrier; G. A. Green (now Act. W/O.); I. C. Handley; G. W. Hayhoe; R. J. C. Llewellyn; D. McKenzie; K. McLaren; P. H. Mason (now W/O.); J. S. Milne; J. R. Pringle; H. Scullion; MacD. S. Sparks; G. Webber; R. E. Whitbourn; H. A. Wright.

Chief Tech. B. Longstaff.

Act. Flight Sergeant B. Barber, W.R.A.F.

Sergeants C. J. Astles; H. Bloore; L. P. Hadfield; J. W. Hosking; J. Thynne-Russell; L. M. Hampson.

Act. Sergeant P. J. McCartan.

Corporals N. B. Lawton; R. Oakes.

Act. Corporal J. N. Whitehead.

KING'S COMMENDATION FOR VALUABLE SERVICE IN THE AIR.

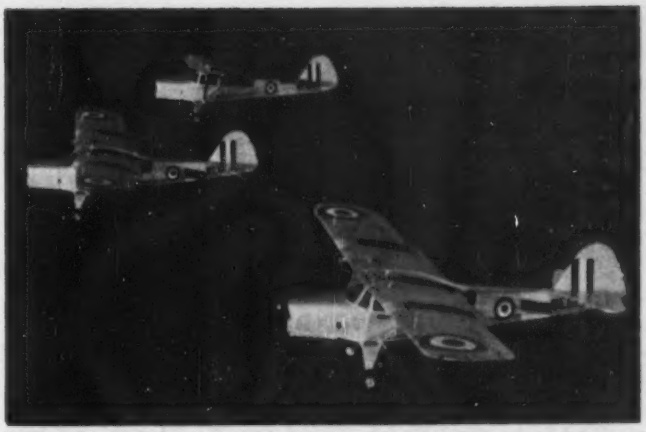
Squadron Leaders R. M. Horsley, D.F.C.; J. L. Kerr; R. B. Morison, D.F.C.; L. G. Press, A.F.C.; K. Ritchley. Act. Squadron Leader M. J. Beetham, D.F.C.

Flight Lieutenants P. G. Adams, D.F.C.; W. G. Bartley; J. J. Bray, D.F.C.; A. W. D. Brazier; E. R. Campbell; D. Carlson; C. Crichton, B.A.; J. Curd; J. Double, D.F.C.; W. N. Gilmer; L. K. Grzybowski; W. A. Hardman, D.F.C.; A. W. Harding; T. L. Hunt; D. E. King, D.F.C.; M. Mays; R. C. Penning; P. H. P. Roberts; W. J. Simpson, D.F.C.; J. W. S. Sinclair, D.F.C.; G. S. Wilkes.

Master Pilot J. J. Mulrooney.

Flight Sergeants W. J. Aitchison; J. S. Burn, D.F.M.; R. C. J. Carey, D.F.M.; G. Crossley; D. J. Hill; J. H. Malloy; J. Moyes; D. W. J. Nicholson; E. Pike; J. E. W. Price; F. H. Stogdale; R. C. Stratton.

Sergeants H. A. Hynds; J. C. Wellby.



THREE IN HAND : A trio of the latest Mk 7 Austers—fitted with the new type of tailwheel—proctise formation work. Designed as a side-by-side trainer, and quickly convertible for A.O.P. duties, the Mk 7 has been supplied to Burma, Canada and Transjordan in addition to the R.A.F.

R.A.A.F. Strength

SHORTLY before Christmas the Australian government announced its intention to recruit a further 4,000 men into the Royal Australian Air Force, bringing the total number of personnel up to 19,000.

Far East Ferry for Vampire 9s.

JUST a year after the first Vampires were flown out from Britain to Singapore, the Royal Air Force has announced the start of a series of two-way ferrying flights, which were due to begin on December 31st and should finish some time in April.

The aircraft to be ferried to Singapore are Vampire F.B. 9s for operation in Malaya, and the pilots of Transport Command Overseas Ferry Unit who take the Vampire 9s out will bring Vampire 5s back on the return journey.

Starting at Abingdon, Oxfordshire, the flights will be made in 18 stages with landings in France, Tunisia, Tripolitania, Libya, Egypt, Persian Gulf, Pakistan, India, Siam and Malaya. The first four aircraft should arrive at Singapore Island on January 13th, the pilots leaving again five days later to arrive back in England on January 29th.

As far as Karachi, Pakistan, the Vampires will fly in pairs or fours. At Karachi they will assemble into flights of six, being joined by two Vickers-Armstrongs Valetta transports from F.E.A.F. These will carry spares and servicing personnel. At Calcutta, India, each group will be joined by a Mosquito, which will act as navigation escort.

The Vampire F.B. 9 is similar to the F.B. 5, but is fitted with the Godfrey cold-air unit, developed to increase the pilot's comfort and efficiency when operat-

TAKING-OFF THE MASTER : As reported on page 33, some 60 schools which have contingents of the Combined Cadet Force are to receive primary gliders, and a number of masters are now receiving training as instructors, at R.A.F. Station, Detling. Here, Mr. J. L. Smith, chemistry master from Dollar Academy, receives advice from F/L. H. D. Piggot before being launched on an Eon Eton primary trainer.

SERVICE AVIATION . . .

ing in tropical climates. The refrigeration unit, the power for which is taken from the Vampire's Goblin turbojet, supplies cooled air to the cockpit, and is designed to reduce an average tropical cockpit temperature of 120 deg F to a figure in the neighbourhood of 95 deg.

Co-operation in Iraq

FOR the third year in succession the R.A.F. and Royal Iraqi Air Force at Habbaniya, Baghdad, have spent a three-week period on combined exercises. Tactics practised included air-to-air and air-to-ground firing, high-level and low-level interception, high-speed bombing attacks and Tac R. The R.A.F. were flying D.H. Vampires and the R.I.A.F. Hawker Furies.

The end of the training period was marked by a demonstration over the air ranges, watched by H.R.H. the Regent of Iraq, Amir Abdul Illah; the Prime Minister, Nuri al Said; the British Ambassador, Sir John Monro Troutbeck; and the C-in-C. M.E.A.F., Air Marshal Sir John W. Baker.

The demonstration concluded with the Vampires and Furies flying in combined formations.

Safety Then and Now

RELATIVE safety as between the Service aircraft of today and those of much earlier years was the theme of an address by A.V-M. A. Hesketh, A.O.C. No. 23 (Training) Group, after presenting wings to 23 National Servicemen at Dalcross, Scotland, last month.

Speaking particularly to the airmen's relatives and friends, who watched the ceremony, A.V-M. Hesketh said there was a tendency to regard jet aircraft as dangerous to fly. Nothing was farther from the truth. Those in use in the R.A.F. today were of extremely high quality; to people who made much of statistics of accidents to jet aircraft he would say that the proportion of the causes of accidents was exactly the same as applied to aircraft right back to when man started to fly—the greatest cause of accidents of any sort was the human element. If airmen continued to add to their skill, the flying of jet aircraft need not have any worries whatsoever for them.

Off/Cdt. R. B. Green gained the Bridgeman and Burns trophy for the best all-round student on the course and earned a special commendation in ground subjects. P/O. D. Whitan received a special commendation for flying and leadership training.

Half-Yearly Promotions

THE following half-yearly list of promotions are announced by the Admiralty and Air Ministry:—

NAVAL AVIATION

Commander to Captain.—K. Williamson, D.S.O.; A. J. Talbot Roe, D.S.O., O.B.E.; R. E. N. Kearney, O.B.E.

Lieutenant Commander to Commander.—A. F. Paterson; J. W. Collett; A. T. Darley; G. R. Callingham; R. M. Rosne; J. G. Baldwin, D.S.C.; T. G. V. Percy, D.S.C.

Commander (E) to Captain (E).—C. G. Webley, O.B.E.

Lieutenant Commander (E) to Commander (E).—P. Richmond; J. E. Dyer-Smith; P. S. Wilson, A.F.C.; E. H. Banfield, A.F.R.Ae.S., M.I.E.I.

Commander (L) to Captain (L).—G. R. B. Pattison; G. C. F. Whitaker.

Lieutenant Commander (L) to Commander (L).—R. Kemp; W. F. H. Lamacraft; W. E. Smith; J. C. Webber.

ROYAL AIR FORCE

Air Vice-Marshal to Air Marshal.—V. E. Groom, C.B., C.B.E., D.F.C., A.O.C., No. 205 Group; Sir John N. Boothman, K.B.E., C.B., D.F.C., A.F.C. (Act. Air Marshal), Controller of Supplies (Air), Ministry of Supply.

Air Commodore (Act. A.V-M.) to Air Vice-Marshal.—A. McKee, C.B., C.B.E., D.S.O., D.F.C., A.F.C., A.O.C., No. 21 Group; The Earl of Bandon, C.B., D.S.O., A.O.C., No. 11 Group; J. G. Hawtrey, C.B.E., S.A.S.O., F.E.A.F.; G. W. Tuttle, C.B., O.B.E., D.F.C., Assistant Chief of the Air Staff (Operational Requirements); E. C. Hudleston, C.B., C.B.E., Deputy Chief of Staff Plans, H.Q., S.H.A.P.E.; C. P. Brown, C.B., C.B.E., D.F.C., Asst. Controller of Supplies (Air), M.o.S.; E. D. D. Dickson, C.B.E., M.B., Ch.B., F.R.C.S.(E), D.L.O., K.H.S., Senior Consultant, R.A.F., Central Medical Establishment.

Group Captain to Air Commodore.—J. Warburton (Sen 1-7-51); J. B. M. Wallis, O.B.E.; J. Cox, O.B.E., D.F.C.; W. H. Hutton, C.B.E.; F. J. St. G. Braithwaite, C.B.E.; W. M. L. MacDonald, C.B.E., D.F.C.; D. W. Lane, C.B.E.; E. M. F. Grundy, O.B.E.; G. B. Keily, D.F.C., A.F.C.; M. Watson, C.B.E.; H. L. Messiter; G. P. O'Connell, M.B., B.Ch.; C. A. Rumbell, O.B.E., M.R.C.S., M.R.C.P., D.T.M. & H., D.P.M., L.D.S., K.H.P.

Wing Commander to Group Captain.—G. J. L. Read, A.F.C.; J. H. Hill, C.B.E.; R. N. McKern; R. H. Shaw, D.F.C.; G. R. Howie, D.S.O.; A. W. B. Barrett; R. C. Keary; P. J. Sanders, D.F.C.; B. A. C. Wood, D.F.C.; J. B. Voyce, D.F.C.; C. E. Slee, M.V.O., A.F.C.; L. Fox, D.S.O., D.F.C.; A. G. F. Stewart; W. E. Rankin, D.S.O.; J. C. Sisson, C.B.E., D.F.C.; H. J. Maguire, D.S.O., O.B.E.; C. L. Truop; G. F. A. Skelton, O.B.E.; F. F. Rainsford, C.B.E., D.F.C.; N. de W. Boult, D.F.C., A.F.C.; F. J. Manning, C.B.E.; L. J. Stickley, O.B.E., D.F.C.; J. F. Roulston, C.B.E., D.S.O., D.F.C.; P. G. Jameson, D.S.O., D.F.C.; R. C. Porteous, D.S.O.; R. N. Bateson, D.S.O., D.F.C.; A. A. F. Hickman, O.B.E., A.F.R.Ae.S.; R. W. Christmas, O.B.E.; J. K. Rotherham, O.B.E., B.A., D.I.C.; W. F. Beckwith, C.B.E., B.Sc.(Eng.), A.C.G.I.; P. G. Bullen; C. J. Salmon, O.B.E.; P. W. Wiseman-Clark, M.B.E.; J. F. Sandow, O.B.E., M.R.C.S., L.R.C.P.; W. P. Stamm, M.B., B.S., M.R.C.S., M.R.C.P., D.C.P., D.T.M. & H.

Wing Officer to Group Officer.—J. L. A. Conan-Doyle, O.B.E., W.R.A.A.F.

Squadron Leader to Wing Commander.—E. H. Lynch-Blosse; V. Rees, D.F.C.; J. E. J. Sing, D.F.C.; J. B. Wray, D.F.C.; R. B. Langlois, D.F.C.; J. D. Kirwan, D.F.C.; F. G. Foot; H. C. Randall, D.F.C.; A. M. Campbell; P. G. D. Farr, D.F.C.; K. C. Roberts, A.F.C.; P. C. Webb, D.F.C.; K. H. Blair, D.F.C.; W. A. Griffiths, D.F.C.; R. C. E. Law, D.S.O., D.F.C.; J. Wallace, D.S.O., D.F.C.; W. D. David, D.F.C., A.F.C.; E. W. Tacon, D.S.O., M.V.O., D.F.C., A.F.C.; S. G. Baggott, D.F.C.; L. J. Joel, D.F.C.; R. M. MacKenzie, D.S.O., D.F.C., A.F.C.; T. Balmforth, D.S.O., D.F.C.; A. H. C. Boxer, D.S.O., D.F.C.; E. D. Crew, D.S.O., D.F.C.; J. G. Topham, D.S.O., D.F.C.; A. P. Dottridge, D.F.C.; J. Northrop, D.S.O., D.F.C., A.F.C.; P. N. Smith, D.F.C., A.F.C.; G. G. Petty, D.S.O., D.F.C.; B. L. Duigan, D.S.O., D.F.C.; D. T. Witt, D.S.O., D.F.C., D.F.M.; W. T. H. Howell, D.F.C.; C. S. G. Stanbury, D.S.O., D.F.C.; J. H. Hoskins, D.S.O., D.F.C.; F. M. Osborn, O.B.E., D.F.C., A.F.C.; A. Ingle, D.F.C., A.F.C.; J. W. E. Holmes, D.F.C., A.F.C.; D. L. Pitt, D.S.O., D.F.C., A.F.C.; B. R. W. Hallows, O.B.E., D.F.C.; E. P. Wells, D.S.O., D.F.C.; C. R. A. Forsyth, D.S.O.; E. Donovan, D.F.C.; R. C. Haine, D.F.C.; P. J. Cundy, D.S.O., D.F.C., A.F.C.; C. H. Saunders, D.F.C.; J. D. W. Willis, A.F.C.; A. H. W. Ball, D.S.O., D.F.C.; H. A. Jenkins, D.F.C.; N. M. Maynard, D.F.C., A.F.C.; J. A. T. Bowen; J. F. Brown, B.E.M.; R. A. Harding; F. P. Woodcraft; W. R. Scrivener; T. R. Knight; F. T. Baynham; R. W. Searles; W. F. Wallington, D.F.C.; H. W. Gill, A.F.M.; D. C. Perry; B. E. Bunkley, A.M.I.Mech.E., A.F.R.Ae.S.; R. Hill; E. Hearl; S. H. Bonser, M.B.E., B.Sc.(Eng.); J. S. Rowlands, G.C., M.B.E., B.Sc.; E. C. Davies; G. H. Tebboth; J. B. Taylor, O.B.E.; F. M. Watts; J. A. D. Sturges; S. L. Swain; G. P. Howell; J. Hamilton; J. E. M. Mould; G. P. S. Thomas, O.B.E.; E. M. Sopwith, O.B.E.; G. E. Tweddle; T. F. H. Hudson; H. E. Barker, O.B.E.; H. T. Morgan; P. R. Ap Ellis; E. V. Cunliffe, M.B.E.; F. W. T. Pryer, O.B.E.; E. V. Masters, M.B.E.; F. T. Solis; L. C. J. Smith; E. Johnson; R. P. Burton, M.B.E.; L. C. Inglefield; V. E. G. Alton; G. S. Nangle, D.S.O., O.B.E.; G. Tate, D.F.C.; F. J. Trollope, M.C.; E. H. Roberts, M.B.E.; D. C. Light, M.R.C.S., L.R.C.P., D.M.R.D.; W. C. Baird, M.R.C.S., L.R.C.P.; R. McP. Cross, L.R.C.P. & S., D.T.M. & H.; M. N. Phillips, M.B., Ch.B.; H. W. Wittingham, M.B., Ch.B., M.R.C.S., L.R.C.P.; J. W. Garraway, M.B., B.S., M.R.C.S., L.R.C.P.; P. J. O'Connor, O.B.E., M.D., B.Ch., M.R.C.P.(E.); J. A. MacCarthy, O.B.E., G.M., M.B., B.Ch.; F. S. Krusin, B.D.S., M.R.C.S., L.R.C.P.; R. Scott

Squadron Officer to Wing Officer, W.R.A.F.—M. F. Arkell; I. D. Kingsley.

(To be continued)

ARRIVAL FROM BRITAIN: A batch of Spitfire 24s at Belvedere, Salisbury, Southern Rhodesia, after being ferried out from Britain by pilots of the S.R.A.F. The flight, commanded by Capt. H. Hawkins, D.F.C., was greeted on arrival by the Prime Minister, Sir Godfrey Huggins.

Reunion

ALL officers, R.A.F., W.A.A.F., Dominion or Allied, who served in 25 and 29 Groups are invited to attend a reunion at the Westminster Arms, Page Street, London, S.W.1, at 6.30 p.m. on February 15th. Those desirous of attending are asked to send a remittance of 7s to A.V-M. E. D. Davies, Room 449, Shell-Mex House, Strand, London, W.C.2, marking the envelope "25/29 Groups."

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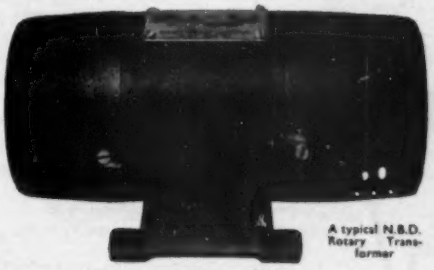

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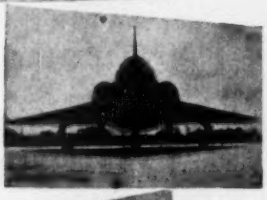

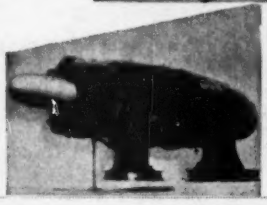

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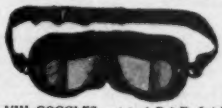

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GATWICK AIRPORT HORLEY SURREY

SITUATIONS VACANT

HANDLEY PAGE, Ltd., have vacancies for:—
AERODYNAMICISTS of degree standard or with H.N.C. in aero subjects. Previous experience preferred.
WIND tunnel technicians of degree standard or with H.N.C. in aero subjects. Previous experience preferred.
STRESSMAN of degree standard or with H.N.C. in aero subjects. Previous experience preferred.
WEIGHT control engineers with minimum qualifications of O.N.C. Previous experience preferred.
SENIOR design and intermediate draughtsmen, preferably with aircraft experience, for Cricklewood and Radlett offices. Consideration will be given to applicants with experience in light structural or mechanical engineering. Possession of I.N.C. or H.N.C. (Mech. or Elect.) an advantage.
LOFTSMEN with previous experience of full scale layout work or similar workshop practice.
TECHNICAL authors, preferably with experience in the preparation of maintenance manuals, pilots' notes, technical specifications, etc.
TECHNICAL illustrators with previous experience in aircraft work.—Write, stating age, qualifications and details of experience, to: Staff Officer, Handley Page, Ltd., Cricklewood, London, N.W.2. [7231]

NORMALAIR, Ltd., Yeovil, Somerset, require:—
DESIGNERS.
DRAUGHTSMEN.
TECHNICAL ASSISTANTS.
TECHNICAL CLERKS.
TECHNICAL ILLUSTRATORS.
TECHNICAL WRITERS.
FOR design development, etc., of aircraft air conditioning and high altitude breathing equipment.
APPLY, giving age, experience, qualifications and salary required, to Personnel Officer.
LOCAL interviews arranged for selected applicants. [7511]

SENIOR draughtsman required for test bed installation design and detailing on guided weapons.
PAST experience in a similar capacity in aircraft of aero engine office preferred.
EDUCATION to National Certificate Standard desirable.
APPLY, giving full particulars of age, experience, salary required, etc., to Box 6121, quoting reference C6. [7509]

WESTLAND AIRCRAFT, Ltd., Yeovil, Somerset, require:—
SENIOR and intermediate draughtsmen. Stressmen.
EXPERIENCED spares compilers.
APPLICANTS should state age, experience, qualifications and salary required, to Personnel Officer. [7510]

THE BRISTOL AEROPLANE Co., Ltd., have vacancies with good prospects for advancement for:—
1. Technicians for work on guided weapons. Aerodynamicists with degree and not less than one year's practical experience and with some knowledge of supersonics preferred.
2. Draughtsmen and senior draughtsmen with Higher National Certificate and experience on aircraft or light engineering work.
Apply, giving full particulars of experience, age and academic qualifications, to the Personnel Manager, the Bristol Aeroplane Co., Ltd. (Aircraft Division), Filton House, Bristol. [7474]

APPLICATIONS are invited for the following positions in the Aircraft Division of the English Electric Co., Ltd., at Warton Aerodrome, near Blackpool.
1 Engineer for the design and development of a new supersonic wind tunnel project. Applicants should have good experience of this type of work. Degree or equivalent preferred. (Ref. 903A.)
2 Engineer for flight test liaison with the South of England. Applicants should have technical experience in the aircraft industry and an honours degree in engineering or its equivalent. (Ref. 953A.)
3 Engineers for aero-elastic and allied investigations. Applicants should have aerodynamic or structural training and experience. (Ref. 636H.)
4 Engineer/mathematician for investigations into mechanical methods for aerodynamic and allied calculations. Applicants should be graduates of first-class mathematical ability. (Ref. 954A.)
PLEASE write, giving full details and quoting appropriate reference to English Electric Co., Ltd., Central Personnel Services, 24/30, Gillingham Street, London, S.W.1. [7469]

COMPLETE staff required for a basic flying training school to be opened at the end of February, 1952, at Desford, Leicester.
FLYING instructors "B" cat. minimum. Link trainer operators. Air traffic controllers. Ground instructors.
APPLY, giving full particulars to:—
CHIEF Instructor, 5 B.F.T.S., Desford, Leicester. [7490]

INDUSTRIAL draughtsmen for urgent design, drawing, tracing and plan reproduction.—P.O. Box 68, Worcester Park Surrey. [7472]

CHIEF draughtsman required. Top salary plus bonus. Write full details in confidence to—Microcell, Ltd., 109, Kingsway, W.C.2. [7503]

SENIOR design draughtsman for important aircraft components. Top salary, plus bonus.—Write full particulars in confidence to: Microcell, Ltd., 109, Kingsway, W.C.2. [7501]

FIRST-class stressman to B.Sc. standard for aircraft structures. Top salary plus bonus. Write full details in confidence to—Microcell, Ltd., 109, Kingsway, W.C.2. [7502]

LICENSED engineers, A and C, or A, for light aircraft maintenance; C, of A, repairs and club duties; also fitters, airframe and engine required, good rate of pay and prospects.
APPLY: Wolverhampton Aviation, Ltd., The Airport, Wolverhampton. [7526]

ESTIMATORS and ratefixers required, accustomed to aircraft work, for the south-west area.—Write, giving full particulars, to Box L4043, A.K. Advg., 32a Shaftesbury Avenue, W.C.1. [7467]

ONE junior weight engineer required for work on aircraft structures and guided missiles.—Please write, giving full particulars of age, experience, salary required etc., to Box 6130, quoting reference F17. [7508]

LICENSED radio engineer and radio mechanics at our base at Stansted Airport, Essex.—Apply by letter or telephone, to the Senior Radio Engineer, Aviation Traders Ltd., Southend Airport, Essex. Tel.: Rochford 36491. [0060]

JIG and tool draughtsmen required, fully experienced.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds., stating age, experience and salary required. [0060]

SITUATIONS VACANT

APPLICATIONS are invited from design draughtsmen and stressmen, also technical assistants with combined design and performance experience for work on both reciprocating and gas turbine aero engines.

APPLICATIONS should state full particulars of experience and qualifications, and should be addressed to The Personnel Manager, The de Havilland Engine Co., Ltd., Stonegrove, Edgware, Middx. [7675

AIRCRAFT draughtsmen required for new premises by expanding firm. Also technical authors, preferably with electrical experience.—Write or phone Aviation Engineering Projects Ltd., 187, High Street, Hounslow 6442. [7516

LANCASHIRE AIRCRAFT CORPORATION invite applications for an experienced buyer to be based at Rivington. Salary according to experience and qualifications.—Apply, in writing, to 11, Berkeley Street, W.1. [7504

YOUNG development engineer required for new and interesting project. Sound knowledge of dynamics and mechanical design essential; experience of shock absorption would be an advantage.—B. Dixon-Bate, Ltd., Chester. [7477

A TECHNICAL assistant for interesting and varied work in modern test laboratory of heat exchange equipment. Age 21-28.—Please apply in writing, stating age, experience and qualifications, to: Secretary, Delaney Gallay, Ltd., Cricklewood, N.W.2. [7506

AIRCRAFT fitter assemblers required by de Havilland Aircraft Co., Hatfield. Good working conditions, modern equipment, superannuation scheme, opportunities for advancement.—Apply in person or by letter to Personnel Manager, or telephone Hatfield 3246. [7530

AIRCRAFT design draughtsmen, excellent opportunities exist for men with real designing ability.—Please apply, stating age, qualifications and full experience, to Personnel Supervisor, Hawker Aircraft, Ltd., Kingston-on-Thames. [7454

TECHNICAL authors and illustrators required. Knowledge of M.o.S. procedure desirable.—Applications, in writing, stating age, experience and salary required to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds. [7524

WRIGHT estimator required for work on fixed wing and helicopter aircraft. Apply, giving details of age, qualifications, experience and salary required to: Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [7092

GROUND instructor, ex-R.A.F., required to give lectures on aerodynamics, airmanship, navigation and meteorology to R.A.F. Reservists.—Apply, stating age, experience, to the Manager, No. 6 Reserve Flying School, Sywell Aerodrome, Northampton. [7480

DESIGNER draughtsmen required for interesting work on gas turbine aero engine test equipment. The work covers the design and detail of equipment for research, experimental and production projects for initial engine built to procedure to component testing and final testing.

SALARIES in excess of £600 per annum will be considered for applicants capable of working on own initiative. Experience paid to interview.—Apply to Reference No. 1201, Personnel Manager, Armstrong Siddeley Motors, Ltd., Coventry. [7467

SENIOR and junior weight engineers required. Interesting work on new projects. Permanent positions offered to suitable applicants.—Apply, stating age, experience, qualifications and salary required, to Chief Designer, Gloster Aircraft Co., Ltd., Witcombe, Glos. [7012

THE DE HAVILLAND AIRCRAFT COMPANY, LTD., Christchurch Aerodrome, Hampshire, have vacancies for the following: Experienced electrical engineering draughtsmen required accustomed to aircraft installation work.—Apply in writing to the Personnel Manager, stating age, experience, and salary required. [7518

GLOSTER AIRCRAFT Co., Ltd., have vacancies for fully experienced aircraft structural and electrical draughtsmen.—Applications, in writing, stating age, experience and salary required, to Engineering Staff Officer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [6910

SURREY FLYING SERVICES, Ltd., urgently require aircraft for "Work" contract. Night navigation. Radio officers must be in possession of current licences. Corporation rates of pay.—Apply by letter or phone, Surrey Flying Services, Ltd., 74, Buckingham Gate, S.W.1. [7051 Whitehall 0096.

AIRCRAFT estimator required, fully conversant with general construction and preferably already employed in similar capacity. Applications to the Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds, stating age, experience and salary required. [7509

RADIO officers required for service with Sudan Airways, Khartoum. Excellent starting salary, plus 25 per cent. expatriation allowance and additional allowances according to size of family. Generous home leave.—Apply Airwork, Ltd., Sutton Lane, Langley, Bucks. For the attention of the Overseas Division. [7464

JIG and tool draughtsmen required for the design of equipment for development of new technique for welding high tensile steel.—Please write, giving details of age, previous experience and salary required, to Mr. A. J. Wilson, Works Manager, British Messier, Ltd., Cheltenham Road East, Gloucester. [7438

APPLICATIONS are invited from senior and intermediate design draughtsmen; experience of servo engine design desirable but not essential.—Please write, stating age and giving details of previous experience in chronological order, to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middx. [7449

ONE male test laboratory assistant required. National Certificate standard and preferably 2-3 years' experience on design and analysis of mechanical tests.—Applications, in writing, stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [7511

TWO draughtsmen are urgently required by engineering firm of repute in the North West district for plant maintenance work. Applicants must have good knowledge of I.C. engine test equipment, also be capable of carrying out designs on their own initiative. Salary according to age and experience. Apply: Box 3625. [7419

PLANNING engineers required by large aircraft firm in the Midlands engaged on attractive and progressive programme of work. Previous aircraft experience desirable, but not essential. Interviews will be arranged locally where possible. Apply, stating age, experience and salary to Box 5772. [7400

DRAUGHTSMEN of all grades are required by the Aircraft Division of the English Electric Co., Ltd., for employment at Warton or in West London. Though men with good aircraft structure or jet engine installation experience are preferred, those with other light structural experience will be considered.—Write, giving full particulars, quoting Ref. 1250, to Central Personnel Services, English Electric Co., 26/30 Gillingham Street, London, S.W.1. [7462

SITUATIONS VACANT

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Porthouse, Wolverhampton. [7432

EXPERIENCED stressman required, for responsible position in stress office. Minimum requirements B.Sc. (or equivalent), several years' experience, ability to take charge of stressing of complete aircraft. Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds, giving details of training, experience, age and salary required. [7506

IMPORTANT Midlands aircraft engine manufacturer has vacancies for a number of designers and senior and junior draughtsmen. The work is connected with gas turbine engines. Although experience is most advantageous it is not necessarily essential, as training will be given.—Apply in some detail, please, to Armstrong Siddeley Motors, Ltd., Reference 101, Coventry. [7415

A.I.D. FORCE. Small land helicopter aircraft all under design and development at Percival Aircraft, Ltd. Applications are invited from senior and junior draughtsmen, and others for work on this interesting programme.—Write, giving details of experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds. [7505

STRESSMEN, both intermediate and senior for work on special projects, including guided missiles. Aircraft stressing experience desirable. Good salaries to suitably qualified men, together with consideration for housing accommodation. Full details of experience, qualifications and salary required, to Box 6119, quoting reference F/S. [7507

THE DE HAVILLAND AIRCRAFT Co., Ltd., have a few vacancies in the aerodynamics department, which covers a wide range of technical work. Applicants with engineering degree preferred, but sound technical training essential.—Write, stating age, qualifications, experience, and salary required, to the Chief of Aerodynamics Department, de Havilland Aircraft Co., Ltd., Hatfield, Herts. [7513

THE BRISTOL AEROPLANE Co., Ltd., require for aircraft work, senior and other draughtsmen with National or Higher National Certificates for their Filton and London design offices. Mechanical engineering draughtsmen for the Filton area are also required.—Apply in writing, giving full details of experience, age, etc., to the Personnel Manager, the Bristol Aeroplane Co., Ltd. (Aircraft Division), Filton House, Bristol. [7475

THE GLOSTER AIRCRAFT Co. requires senior and intermediate stressmen to work on designs and projects of advanced interest. Excellent prospects of advancement for sound and energetic men.—Apply, in the first instance, giving full particulars of technical qualifications, age, experience and salary required, to The Chief Designer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [6911

HANDLEY PAGE, Ltd., have a vacancy for a technical assistant with a good mechanical engineering background, who will be required to carry out in connection with test-rig development work for aircraft air conditioning and thermal de-icing systems.—Write, stating age and giving particulars of qualifications and experience, to: Staff Officer, Handley Page, Ltd., Claremont Road, London, N.W.2. [7336

EXPERIENCED aerodynamicist required, for responsible position in aerodynamics department. Minimum requirements B.Sc. (or equivalent), several years' experience, ability to undertake all normal performance, stability and other aerodynamic work.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds, giving details of training, experience, age and salary required. [7500

TECHNICAL assistant with junior and senior, required in mechanical engineering department for work of national importance in connection with development of gas turbine engines. Excellent prospects exist in sections allied with rig test development, components, vibration static structure test and research in gears and bearings. Qualifications: degree or H.N.C.—Apply: Reference No. VI, Armstrong Siddeley Motors, Ltd., Coventry. [7502

DESIGN engineers wanted for experimental work on defence project. Previous experience required of any of the following: light engineering instruments, aircraft design, small electrical devices. Salary in accordance with experience and qualifications.—Please write giving full details, and salary required, quoting ref.: 254D to Central Personnel Services, English Electric Company, Ltd., 26/30, Gillingham Street, London, S.W.1. [7517

INTERNATIONAL AERADIO Ltd., offers careers to Air Traffic control officers required as overseas airports. Basic salary from £400 to £900 p.a. plus adequate overseas allowance to cover local conditions, free air passages for staff and families. Local paid leave annually, and paid U.K. leave every 2/3 years. Pensions and insurance funds. Kit allowance.—Write Personnel Officer, 40, Park Street, London, W.1. [7518

THE DE HAVILLAND AIRCRAFT COMPANY LTD., Christchurch Aerodrome, Hampshire, have vacancies for the following: Senior method engineers with experience in machine shop, sheet metal or fitting shop. Senior and junior jig and tool designers. Preferably with experience of assembly jigs as well as small tools.—Apply in writing to the Personnel Manager, stating age, experience, and salary required. [7520

HANDLEY PAGE (Reading), Ltd., The Aerodrome, Woodley, Reading, have a vacancy in their Design Office for a senior draughtsman with good experience and a degree or Higher National Certificate with endorsements in aeronautical subjects. Also required is a qualified weights control engineer to take charge of small weights section.—Please write full particulars to the Personnel Officer. [7574

HANDLEY PAGE, Ltd., have vacancies for: (a) junior and assistants, male or female, work in their test house at Cricklewood, on material and process control; (b) junior and senior assistants of H.N.C. or degree standard for work in their mechanical and structural test dept. at Radlett.—Write, stating age and full particulars of qualifications and experience, to Staff Officer, Handley Page, Ltd., Claremont Road, London, N.W.2. [7336

BRITISH OVERSEAS AIRWAYS CORPORATION urgently require draughtsmen at London Airport, experienced in airframe or aircraft engine design covering development, research modifications and repairs, etc. Applicants with experience in other forms of engineering may also apply. Education to Ordinary National Certificate standard desirable. A.E.S.D. rates of pay, ranging according to age, from £6 5s. 6d. to £8 per week. Proficiency pay may be earned up to 30s. per week, according to qualifications and experience. Good pension, sickness and holiday scheme facilities.—Apply, in writing, to Staff Manager, London Airport, Feltham, Middlesex. [7494

SITUATIONS VACANT

SENIOR technical assistant required for weight investigation of gas turbine design schemes. Some engine design and/or stress experience desirable. Good opportunity for young engineer with H.N.C. to broaden experience, work involves some engine stressing.—Applicants should write, giving age and previous experience in chronological order, to the Personnel Officer, The de Havilland Engine Co. Ltd., Stag Lane, Edgware, Middlesex. [7498

TECHNICAL authors with experience of aircraft servicing and maintenance are required for the preparation of descriptive and servicing manuals, servicing schedules, pilots' notes, etc. Special consideration will be given to men with R.A.F. qualifications.—Write, giving full particulars of experience, qualifications, age, also salary required, to the Labour Manager, A. V. Roe & Co., Ltd., Greenside Middleton, Manchester. [7446

NORMALAIR, Ltd., have vacancies for instrument mechanics with current "A" licences, for repair and overhaul of air conditioning and high altitude breathing equipment at London Airport. Rates of pay 2s. 4d. per hour, plus 3d. per hour bonus, and ability pay up to 3d. per hour, 5-day 44-hour week. Selected applicants will be given an initial course at Yeovil.—Apply, Personnel Officer, Normalair Limited, Yeovil, Somerset. [7444

LIAISON engineer required in technical sales department of large light engineering company situated in East London area. Applicants must be technically trained and should have experience of light oil hydraulics and its special application to machine tools. Previous experience of sales engineering and liaison work is desirable. The position is permanent and offers excellent prospects.—Applicants should state full details to Box 6104. [7497

TECHNICAL assistant required: one senior (Degree standard) and one junior (Higher National standard), for analysis of engine performance figures obtained to follow on flight trials. Applicants should have good basic training in mathematics and physics, including thermodynamics, and preferably with some aerodynamics training and experience. Location within 25 miles of London. —Apply, with full particulars, details of training, etc., to Box 3040, quoting reference E.2. [7458

AIR-INDIA INTERNATIONAL, Ltd., have a vacancy in their maintenance dept., at London Airport, for a "C" licensed aircraft engineer covering Cyclone C18BD1 engines. Applicants will be required to obtain an equivalent Indian Ground Engineer's license and arrangements will be made for a short visit to Air-India headquarters in Bombay for this purpose.—Applications, stating full particulars and salary required, should be submitted to: Technical Manager (Europe), Air-India International, Ltd., 35, Curzon Street, London, W.1. [7489

A VACANCY exists at the Supermarine Works of Vickers-Armstrongs, Ltd., for a technician in the Flight Test Section at Chilbolton Airfield, who will be engaged on interesting work concerning the development flight testing of new high-performance aircraft. Applicants should possess a degree or Higher National Certificate or equivalent qualification, with aerodynamics as a subject.—Apply to Personnel Manager, Vickers-Armstrongs, Ltd., Hurnley Park, Winchester, giving qualifications, age and experience. [7486

TEST engineers for research and development work in connection with the following interesting work: (a) Small high-pressure hydraulic and electro-hydraulic components. (b) Hydraulic servo for aircraft and special projects. (c) Rig testing of complete aircraft hydraulic systems. Applicants should be at least of Part One Ordinary National Certificate standard. Please write, giving details of age, previous experience and salary required, to Mr. G. C. Oliver, Chief Engineer, British Messier, Ltd., Cheltenham Road East, Gloucester. [7437

THE GLOSTER AIRCRAFT Co. requires the services of a number of aerodynamicists, (a) for design and project work, and (b) for flight test work. Opportunity exists for individuals to vary their experience within the Aerodynamics Department. Candidates with some years' experience preferred, but applications from those with sound mathematical ability will receive full consideration. —Apply, in the first instance, giving full particulars of age, experience and salary required, to The Chief Designer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [6913

AIR-INDIA, Ltd., and Air-India International, Ltd., invite applications for the post of chief engineer in Bombay. Qualifications should include an engineering degree or equivalent, current A, B, C, D licences on modern transport types and considerable practical and administrative experience in the engineering side of airline operating, together with engineering planning. Initial contract for 3 years with 30 days' cumulative leave per year, plus local leave. Salary payable approximately Indian Rs. 2,500 per month (equivalent to £2,250 per annum) or higher if experience and suitability justify.—Written applications in the first instance, with full particulars, to Technical Manager (Europe), Air-India International, Ltd., 35 Curzon Street, London, W.1. [7488

SITUATIONS WANTED

PILOT (28), commercial and R/T licences; just finished training for flight navigator; available for immediate engagement in any kind of flying job.—Box 6078. [7491

SENIOR commercial licensed pilot arriving from Australia January, 2250 hours, including twins and fours, R/T licence, B.I. instructor, current licences, qualified air traffic controller, age 34, desires position.—Box 6106. [7500

EXPERIENCED flight R/O 1st class licence, Age 29, 2,500 hours, Europe, Africa, Australia, seeks responsible lucrative position U.K. or abroad. Ground or airborne; where ability, initiative and keenness appreciated. Free March.—Box 6088. [7184

WANTED

WANTED—quantity of portable oxygen breathing sets, ex-R.A.F., similar to Mark 3 Type 6D/1333.—Box 2800.

BY YOUNG aircraft engineer; detail work, light assembly, parts manufacture, from drawings. Precision work; materials must be provided.—Write Box 6079. [7493

BOOKS, ETC.

CARAVAN homes? See the January "Caravan," out December 24th, for unique buyers' guide.—Order now from your newsagent, 9d., or by post, The Caravan, 24, Store Street, London, W.C.1. [7270

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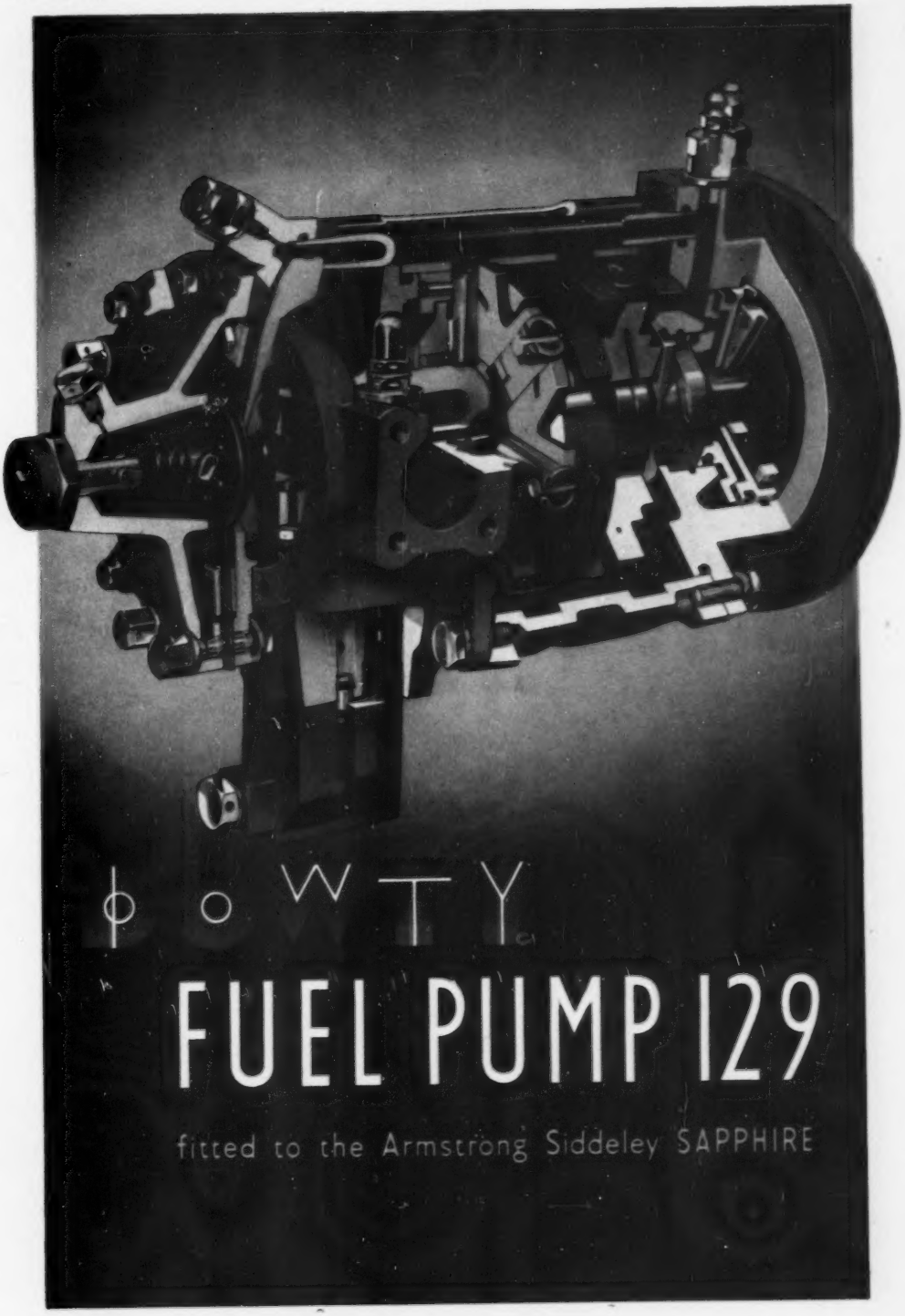
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